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Safety and Health Regulations for Shipbreaking

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PART 1503—SAFETY AND HEALTH REGULATIONS FOR SHIPBREAKING

On August 23, 1963, a proposal to establish safety and health regulations for shipbreaking under section 41 of the Longshoremen's and Harbor Workers' Compensation Act (33 U.S.C. 941) was published in the FEDERAL REGISTER (28 F.R. 9303). Interested persons were provided opportunities to submit data, views, and argument both orally and in writing in regard to the proposals. After consideration of all relevant matter presented, I have decided to and do hereby establish a new 29 CFR Part 1503 to read as set forth below.

The revised regulations shall become effective on April 26, 1964.

Signed at Washington, D.C., this 20th day of March, 1964.

W. WILLARD WIRTZ,
Secretary.

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AUTHORITY: The provisions of this Part 1503 issued under sec. 41, 44 Stat. 1444; sec. 1, 72 Stat. 835; 33 U.S.C. 941.

Subpart A—General Provisions

§ 1503.1 Purpose, scope and responsibility.

(a) Section 41 of the Longshoremen's and Harbor Workers' Compensation Act requires every employer to furnish and maintain employment and places of employment which are reasonably safe for his employees in all employments covered thereby (the Act applies to all injuries sustained by employees on navigable waters of the United States if the employees are employed by an "employer" as defined in section 2(4) of the Act i.e., "an employer any of whose employees are employed in maritime employment, in whole or in part, upon the navigable waters of the United States (including any dry dock)." Calbeck v. Travelers Insurance Co. and Donovan v. Avondale Shipyards, Inc. (52 S. Ct. 1196 (1962)) and to install, furnish, maintain and use devices and safeguards (with particular reference to equipment used by such employers and working conditions established by them) determined by the Secretary of Labor to be reasonably necessary to protect the life, health and safety of such employees, and to render safe such employment and places of employment and to prevent injury to such employees. The purpose of this part is to make determinations under this standard with respect to shipbreaking activity.

(b) This part does not apply to matters under the control of the United States Coast Guard within the scope of Title 52 of the Revised Statutes and acts supplementary or amendatory thereto (46 U.S.C. secs. 1–1388 passim) including, but not restricted to, the master, ship's officer, crew members, design, construction and maintenance of the vessel, its gear and equipment; to matters within the regulatory authority of the United States Coast Guard to safeguard vessels, harbors, ports and waterfront facilities under the provisions of the Espionage Act of June 17, 1917, as amended (50 U.S.C. 191 et seq.; 22 U.S.C. 401 et seq.); including the provisions of Executive Order 10173, as amended by Executive Orders 10277 and 10352 (3 CFR 1949–1953 Comp., pp. 356, 778 and 873); or to matters within the regulatory authority of the United States Coast Guard with respect to lights, warning devices, safety equipment and other matters relating to the promotion of safety of lives and property under section 4(e) of the Outer Continental Shelf Lands Act (43 U.S.C. 1333). Also, this part does not apply to owners, operators, agents or masters of vessels unless they are acting as "employers". However, this part is not intended to relieve owners, operators, agents or masters of vessels who are not "employers" from responsibilities or duties now placed upon them by law, regulations or custom.

(c) The responsibilities placed upon the competent person herein shall be deemed to be the responsibilities of the employer.

§ 1503.2 Definitions.

(a) The term "shall" indicates provisions which are mandatory.

(b) The term "Secretary" means the Secretary of Labor.

(c) The term "employer" means an employer any of whose employees are employed, in whole or in part, in shipbreaking or related employments as defined in paragraphs (i) and (j) of this section on navigable waters of the United States, including dry docks, graving docks and marine railways, and any of whose employees are employed in maritime employment, in whole or in part, upon the navigable waters of the United States, including dry docks, graving docks and marine railways.

(d) The term "employee" means any person employed in shipbreaking or related employments on the navigable waters of the United States, including dry docks, graving docks and marine railways, by an employer as defined in paragraph (c) of this section.

(e) The term "gangway" means any ramp-like or stair-like means of access provided to enable personnel to board or leave a vessel including accommodation ladders, gangplanks and brows.

(f) The term "vessel" includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water, including special purpose floating structures not primarily designed for or used as a means of transportation on water.

(g) For purposes of § 1503.44, the term "barge" means an unpowered, flat bottom, shallow draft vessel including scows, carfloats and lighters. For purposes of this section, the term does not include ship shaped or deep draft barges.

(h) For purposes of § 1503.44, the term "river tow boat" means a shallow draft, low free board, self-propelled vessel designed to tow river barges by pushing ahead. For purposes of this section, the term does not include other towing vessels.

(i) The term "shipbreaking" means any breaking down of a vessel's structure for the purpose of scrapping the vessel, including the removal of gear, equipment or any component part of a vessel.

(j) The term "related employments" means any employments performed as

an incident to or in conjunction with shipbreaking work, including, but not restricted to, inspection, survey and employment as a watchman.

(k) The term "hazardous substance" means a substance which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritant or otherwise harmful is likely to cause injury.

(l) The term "competent person" for purposes of this part means a person who is capable of recognizing and evaluating employee exposure to hazardous substances or to other unsafe conditions and is capable of specifying the necessary protection and precautions to be taken to ensure the safety of employees as required by the particular regulation under the condition to which it applies. For the purposes of Subparts B and D, the competent person shall be one meeting the requirements of § 1503.10.

(m) The term "confined space" means a compartment of small size and limited access such as a double bottom tank, cofferdam or other space which by its small size and confined nature can readily create or aggravate a hazardous exposure.

(n) The term "enclosed space" means any space, other than a confined space, which is enclosed by bulkheads and overhead. It includes cargo holds, tanks, quarters and machinery and boiler spaces.

(o) The term "hot work" means riveting, welding, burning or other fire or spark producing operations.

(p) The term "cold work" means any work which does not involve riveting, welding, burning or other fire or spark producing operations.

(q) The term "powder actuated fastening tool" means a tool or machine which drives a stud, pin or fastener by means of an explosive charge.

§ 1503.3 Penalty.

(a) As provided in Public Law 85–742, any employer who, willfully, violates or fails or refuses to comply with the provisions of the regulations of this part and any employer or other person who willfully interferes with, hinders or delays the Secretary or his authorized representative in carrying out his duties under subsection (c) of section 41 of the Act by refusing to admit the Secretary or his authorized representative to any place, or to permit the inspection or examination of any employment or place of employment, or who willfully hinders or delays the Secretary or his authorized representative in the performance of his duties in the enforcement of the regulations of this part, shall be guilty of an offense, and, upon conviction thereof, shall be punished for each offense by a fine of not less than $100 nor more than $3,000; and in any case where such employer is a corporation, the officer who willfully permits any such violation to occur shall be guilty of an offense, and, upon conviction thereof, shall be punished also for each offense by a fine of not less than $100 nor more than $3,000.

(b) The liability under this provision of Public Law 85–742 shall not affect any other liability of the employer under the Longshoremen's and Harbor Workers' Compensation Act.

§ 1503.4 Variation from the regulations of this part.

(a) As provided in Public Law 85–742, in case of practical difficulties or unnecessary hardships, the Secretary in his discretion may grant variations from the regulations of this part or particular provisions thereof, and permit the use of other or different devices if he finds that the purpose of the regulation will be observed by the variation and the safety of employees will be equally secured thereby. Any person affected by such regulations or his agent, may request the Secretary to grant such variation, stating in writing the grounds on which his request is based. Any authorization by the Secretary of a variation shall be in writing, shall describe the conditions under which the variation shall be permitted, and shall be published as provided in section 3 of the Administrative Procedure Act (ch. 324, 60 Stat. 237), as amended. A properly indexed record of all variations shall be kept in the Office of the Secretary and be open to public inspection.

§ 1503.5 Reference specifications, standards and codes.

(a) Specifications, standards and codes of agencies of the United States Government, to the extent specified in the text, form a part of the regulations of this part. In addition, under the authority vested in the Secretary under the Act, the specifications, standards and codes of organizations which are not agencies of the United States Government, in effect on the date of the promulgation of the regulations of this part as listed below, to the extent specified in the text, form a part of the regulations of this part:

National Fire Protection Association, 60 Batterymarch Street, Boston 10, Mass., Subpart B, § 1503.13(b).

Underwriters' Laboratories, Inc., 207 East Ohio Street, Chicago, Ill., Subpart B, § 1503.12(b).

American Standard Safety Code for Portable Wood Ladders, A14.1—1959, American Standards Association, Inc., 10 East 40th Street, New York 16, N.Y., Subpart E, § 1503.42(a)(6).

American Standard Safety Code for Portable Metal Ladders, A14.2—1956, American Standards Association, Inc., 10 East 40th Street, New York 16, N.Y., Subpart E, § 1503.42(a)(4).

American Standard Safety Code for Head, Eye and Respiratory Protection, Z2.1—1959, American Standards Association, Inc., 10 East 40th Street, New York 16, N.Y., Subpart I, §§ 1503.81(a)(1), 1503.83(b).

§ 1503.6 Notification of accidents resulting in fatalities or serious injuries.

(a) Within 48 hours after the occurrence of an accident causing the death of an employee or resulting in an employee's admission to a hospital as a bed patient, the employer shall file a copy of Bureau of Employees' Compensation Form BEC—202 (approved by Budget Bureau No. 44–R887.3) with the Field Safety Consultant of the Bureau of Labor Standards serving the area where the accident occurred (in addition to such filing as is required by 20 CFR 31.3) unless prior thereto and as soon after the accident as feasible the employer has given oral or written notice of the accident to the person in charge of such office in sufficient detail to permit the accident to be identified readily. (44 Stat. 1444; 33 U.S.C. 930)

§ 1503.7 Amendment of the regulations of this part.

The Secretary may at any time, upon his own motion or upon written petition of any interested person setting forth reasonable grounds therefor, and after opportunity has been given to interested persons to present their views, amend or revoke any of the provisions of the regulations of this part.

Subpart B—Explosive and Dangerous Atmospheres

§ 1503.10 Competent person.

(a) *Designation.* (1) For the purposes of Subparts B and D of this part one or more competent persons shall be designated by the employer in accordance with the applicable requirements of this section unless the requirements of Subparts B and D of this part are always carried out by an N.F.P.A. Certified Marine Chemist.

(2) The employer shall indicate on U.S. Department of Labor Form MAR–8, "Designation of Competent Person" either those employees designated as competent persons or that the prescribed functions of such persons are always carried out by an N.F.P.A. Certified Marine Chemist in addition to his professional duties. When additions or changes are made in the personnel so designated, a new Form MAR–8 shall be executed. A copy of this executed form shall be forwarded to the nearest office of the Bureau of Labor Standards.

(b) *Criteria.* The following criteria shall guide the employer in designating employees as competent persons:

(1) Ability to understand the meaning of designations on certificates and of any qualifications relating thereto and to carry out any instructions, either written or oral, left by the N.F.P.A. Certified Marine Chemist.

(2) Ability to use and interpret the readings of an oxygen indicator and a combustible gas indicator. The ability to use and interpret the readings of a carbon monoxide indicator and a carbon dioxide indicator, if the operations involve such hazardous gases.

(3) Familiarity with and understanding of Subparts B and D of this part.

(4) Familiarity with the structure and knowledge of the location and designation of spaces of the types of vessels on which breaking work is done.

(5) Capability to perform the tests and inspections required by Subparts B and D of this part and to write the required logs.

(c) *Logging of inspections and tests* (1) When tests and inspections required to be performed by a competent person by any provisions of Subparts B and D of this part are made, a record of the locations, operations performed and date, time, and results of the tests and any instructions resulting therefrom shall be

recorded on U.S. Department of Labor Form MAR–9, "Log of Inspections and Tests by Competent Person." A separate form shall be used for each vessel on which tests and inspections are made.

(2) This record shall be available for inspection in the immediate vicinity of the affected operations while they are in progress. This record or copy thereof shall be kept on file for a period of at least 3 months from the date of the completion of the job.

(3) A copy of any certificate issued in accordance with § 1503.13 and of any instructions issued by the N.F.P.A. Certified Marine Chemist shall be kept on file with the log for a period of at least 3 months from the date of the completion of the job.

(d) *Application.* The provisions of this section are intended to apply in their entirety to employers engaged in general shipbreaking work where both Subparts B and D of this part are applicable. They do not apply in their entirety to employers whose work involves only certain portions of Subparts B and D of this part, such as the breaking of vessels with no exposure to fuel oil or other flammable hazards. In such cases employers may designate persons who are competent on the basis of the applicable portions of the criteria set forth in paragraph (b) of this section.

§ 1503.11 Precautions before entering.

(a) *Gassy atmospheres.* (1) Before employees are initially permitted to enter any of the ship's spaces designated in subdivisions (i) to (iii) of this subparagraph, either the atmosphere shall be considered to be immediately dangerous to life and the employees shall be protected with self-contained breathing apparatus or hose masks with blowers in accordance with § 1503.82 (a) and (b) (2) (i) or (ii), or the atmosphere shall be tested by a competent person to determine whether or not a flammable atmosphere is present.

(i) Cargo spaces or other spaces containing or having last contained combustible or flammable liquids or gases in bulk.

(ii) Cargo spaces or other spaces containing or having last contained bulk liquid or gas cargoes of a poisonous, corrosive, or irritant nature.

(iii) Spaces in tank vessels immediately above or adjacent to those described in subdivisions (i) and (ii) of this subparagraph.

(2) If the atmosphere is found to contain flammable or explosive vapors in concentrations at or above ten (10) percent of their lower explosive limit, either the space shall be ventilated sufficiently to bring the concentration below ten (10) percent of the lower explosive limit and, when necessary, the provisions of subparagraph (4) of this paragraph shall be applied, or employees shall be protected by self-contained breathing apparatus or hose masks with blowers in accordance with § 1503.82 (a) and (b) (2) (i) or (ii).

(3) Only emergency work shall be performed in spaces where conditions exist requiring self-contained breathing apparatus or hose masks as prescribed by subparagraph (2) of this paragraph and paragraph (b) (1) of this section.

(4) If the atmosphere is found to contain a concentration of hazardous contaminants below ten (10) percent of the lower explosive limit and not immediately dangerous to life, but above the threshold limit values for toxic substances, employees shall be protected in accordance with § 1503.82 (a) and (c).

(5) Where tests indicate that no flammable vapors are present the competent person shall test for the presence of sufficient oxygen as specified by paragraph (b) (2) of this section.

(b) *Oxygen deficient atmospheres.* (1) Before employees are permitted to enter sealed compartments, spaces which have been in a state of preservation, or any nonventilated compartments, either the atmosphere shall be considered to be immediately dangerous to life and the employees shall be protected in accordance with the provisions of § 1503.82 (a) and (b) (2) (i) or (ii), or the atmosphere shall be tested by a competent person with an oxygen indicator or other suitable device to ensure that it contains sufficient oxygen to sustain life.

(2) For purposes of this paragraph, an atmosphere containing 16.5 percent oxygen or capable of supporting a flame shall be considered to contain sufficient oxygen to sustain life.

(3) Mechanical ventilation which will provide at least one complete change of uncontaminated air may be substituted in lieu of either of the requirements of subparagraph (1) of this paragraph.

§ 1503.12 Cleaning and other cold work.

(a) Employees shall be permitted to remove residue materials or to perform other cold work in spaces described in § 1503.11(a) (1) (i) through (iii) only under the following conditions:

(1) Liquid residues of flammable and toxic materials shall be removed from the spaces as thoroughly as practicable before employees start actual cleaning operations in these spaces. Drippings and spills of these materials on deck or elsewhere alongside the vessel shall be cleaned up as the work progresses. Special care shall be taken to prevent the spilling or the draining of these materials into the water surrounding the vessel.

(2) Continuous natural or mechanical ventilation shall be provided to keep the concentration of flammable vapors below ten (10) percent of the lower explosive limit in all parts of the space, provided that if, because of the high volatility of the residues, a uniform concentration of less than ten (10) percent of the lower explosive limit cannot be achieved, sufficient exhaust ventilation shall be provided to reduce the concentration to or below that level in the major portions of the compartment.

(3) Tests shall be made by a competent person prior to commencement of cold work and with sufficient frequency thereafter, in accordance with temperature, volatility of the residues and other existing conditions in and about the spaces to ensure that the concentration stated in subparagraph (2) of this paragraph is not exceeded.

(4) Cold work only shall be permitted.

(5) Tests shall be made by a competent person to ensure that the exhaust vapors from these spaces are not accumulating in other areas within or around the vessel, marine railway, dry dock, or under the pier where sources of ignition may be present. Should such accumulations be found, any sources of ignition within the affected area shall be removed or extinguished.

(b) In spaces described in paragraph (b) of § 1503.13 only approved explosion-proof, self-contained, battery-fed portable lamps shall be used. Battery-fed portable lamps bearing the approval of the Underwriters' Laboratories for use in Class I, Group D atmospheres, or approved as permissible by the U.S. Bureau of Mines, and such lamps listed by the United States Coast Guard as approved for such use are deemed to meet the requirements of this paragraph.

(c) Signs shall be posted on the open deck adjacent to the access to spaces described in paragraph (b) of § 1503.13 prohibiting smoking and the use of open flames.

(d) Jet-type air-moving devices shall be electrically bonded to the vessel's structure.

§ 1503.13 Certification before hot work is begun.

(a) *Hot work in the open.* Before hot work is performed from open decks or in tanks or compartments from which the overhead has been completely removed, on the boundaries of cargo spaces or other spaces containing or having last contained combustible or flammable liquids or gases in bulk, the following steps shall be taken:

(1) Tests shall be made by a competent person to determine the concentration of flammable vapors in these spaces. The permissible level of concentration of flammable vapors shall not exceed ten (10) percent of the lower explosive limit in all parts of the spaces.

(2) When the tests indicate that a space contains a concentration of flammable vapors above the permissible concentration, the space shall be inerted with a nonflammable gas or with water, or sufficient ventilation shall be provided to reduce the concentration below the permissible level.

(3) When the bottom of a space contains flammable residues, it shall be flooded with water to cover all parts of the space to a depth of at least one (1) foot unless the space is inerted.

(b) *Hot work below decks.* Employees shall not be permitted to engage in hot work in or on the following spaces, boundaries or pipelines until a certificate setting forth that the hot work can be done in safety is issued. Such certificate shall be acceptable only if issued by a Marine Chemist certificated by the National Fire Protection Association.

(1) On tank vessels:

(i) Within or on the boundaries of cargo tanks which have been used to carry combustible or flammable liquids and gases in bulk, or within spaces adjacent to such cargo tanks.

(ii) Within or on the boundaries of fuel tanks.

(iii) On pipelines, heating coils, pumps, fittings, or other appurtenances connected to such cargo or fuel tanks.

(2) On dry cargo, miscellaneous, and passenger vessels:

(i) Within or on the boundaries of cargo tanks which have been used to carry combustible or flammable liquids and gases in bulk.

(ii) Within spaces adjacent to cargo tanks which have been used to carry flammable gases, or liquids with a flash point below 150° F., except where the distance between such cargo tanks and the work to be performed is not less than twenty-five (25) feet.

(iii) Within or on the boundaries of fuel tanks.

(iv) On pipelines, heating coils, pumps, fittings, or other appurtenances connected to such cargo or fuel tanks.

(3) In dry cargo holds for which a gas free certificate is not required by paragraph (b) (2) (ii) of this section, hot work may be performed only after a competent person has carefully examined the hold and found it to be free of flammable liquids, gases, and vapors. If flammable liquids, gases or vapors are found, hot work shall not be performed within the space until the flammable liquids, gases or vapors have been removed and a test indicates that the space is safe for fire.

(4) Before hot work is performed in engine room and boiler room spaces of any vessel for which a gas free certificate is not required by the provisions of paragraph (b) (1) and (2) of this section or in fuel tank and engine compartments of boats, the bilges shall be inspected and tested by a competent person to ensure that they are free of flammable liquids, gases and vapors. If flammable liquids, gases or vapors are found, hot work shall not be performed within the space until the flammable liquids, gases or vapors have been removed and a test indicates that the space is safe for fire.

§ 1503.14 Maintaining gas free conditions.

(a) *Hot work in the open.* (1) During the performance of hot work from open decks or in tanks or compartments from which the overhead has been completely removed, on the boundaries of spaces described in § 1503.13(a), other than those filled with water, the competent person shall make frequent tests to ensure that the inert atmosphere is being maintained or that the concentration of flammable vapors remains below ten (10) percent of the lower explosive limit.

(b) *Hot work below decks.* (1) When conditions in spaces below decks described in § 1503.13(b) (1) and (2) are such that there is a possibility of hazardous vapors being released from residues or other sources, after a gas free certificate has been issued, a competent person shall make tests to ensure that the gas free condition is maintained irrespective of whether hot work is being performed in or on the aforementioned spaces. When the competent person finds that the atmospheric conditions have altered, work shall be stopped and a new gas free certificate, in accordance with § 1503.13 (b) (1) and (2) shall be obtained, before work is resumed.

Subpart C—[Reserved]

Subpart D—Welding, Cutting and Heating

§ 1503.31 Ventilation and protection in welding, cutting and heating.

(a) *Mechanical ventilation; requirements.* (1) For purposes of this section, mechanical ventilation shall meet the following requirements:

(i) Mechanical ventilation shall consist of either general mechanical ventilation systems or local exhaust systems.

(ii) General mechanical ventilation shall be of sufficient capacity and so arranged as to produce the number of air changes necessary to maintain welding fumes and smoke within safe limits.

(iii) Local exhaust ventilation shall consist of freely movable hoods intended to be placed by the welder or burner as close as practicable to the work. This system shall be of sufficient capacity and so arranged as to remove fumes and smoke at the source and keep the concentration of them in the breathing zone within safe limits.

(iv) Contaminated air exhausted from a working space shall be discharged into the open air or otherwise clear of the source of intake air.

(v) All air replacing that withdrawn shall be clean and respirable.

(vi) Oxygen from a cylinder or torch shall not be used for ventilation purposes.

(b) *Welding, cutting and heating in confined spaces.* (1) Except as provided in subparagraph (3) of this paragraph and paragraph (c) (2) of this section, either general mechanical or local exhaust ventilation meeting the requirements of paragraph (a) of this section shall be provided whenever welding, cutting or heating is performed in a confined space.

(2) The means of access shall be provided to a confined space in accordance with § 1503.46(b) (1) and (2).

(3) When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by air line respirators in accordance with the requirements of § 1503.82(a), and an employee on the outside of such a confined space shall be assigned to maintain communication with those working within it and to aid them in an emergency.

(c) *Welding, cutting or heating of metals of toxic significance.* (1) Welding, cutting or heating in any enclosed spaces aboard the vessel involving the metals specified in this subparagraph shall be performed with either general mechanical or local exhaust ventilation meeting the requirements of paragraph (a) of this section.

(i) Zinc-bearing base or filler metals or metals coated with zinc-bearing materials.

(ii) Lead base metals.

(iii) Cadmium-bearing filler materials.

(iv) Chromium-bearing metals or metals coated with chromium-bearing materials.

(2) Welding, cutting or heating in any enclosed spaces aboard the vessel involving the metals specified in this subparagraph shall be performed with local exhaust ventilation in accordance with the requirements of paragraph (a) of this section or employees shall be protected by air line respirators in accordance with the requirements of § 1503.82 (a).

(i) Metals containing lead, other than as an impurity, or metals coated with lead-bearing materials.

(ii) Cadmium-bearing or cadmium coated base metals.

(iii) Metals coated with mercury-bearing metals.

(iv) Beryllium-containing base or filler metals. Because of its high toxicity, work involving beryllium shall be done with both local exhaust ventilation and air line respirators.

(3) Employees performing such operations in the open air shall be protected by filter type respirators in accordance with requirements of paragraphs (a) and (d) (2) (iv) of § 1503.82, except that employees performing such operations on beryllium-containing base or filler metals shall be protected by air line respirators in accordance with the requirements of § 1503.82(a).

(4) Other employees exposed to the same atmosphere as the welders or burners shall be protected in the same manner as the welder or burner.

(d) *General welding, cutting and heating.* (1) Welding, cutting and heating not involving conditions or materials described in paragraph (b) or (c) of this section may normally be done without mechanical ventilation or respiratory protective equipment, but where, because of unusual physical or atmospheric conditions, an unsafe accumulation of contaminants exists, suitable mechanical ventilation or respiratory protective equipment shall be provided.

(2) Employees performing any type of welding, cutting or heating shall be protected by suitable eye protective equipment in accordance with the requirements of § 1503.81 (a) and (c).

§ 1503.32 Fire prevention.

(a) When hot work is performed below decks or in other situations in which accidental fire would jeopardize the safety of employees the following precautions shall be taken:

(1) When practical, objects to be welded, cut or heated shall be moved to a designated safe location or, if the object to be welded, cut or heated cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place.

(2) If the object to be welded, cut or heated cannot be moved and if all the fire hazards cannot be removed, positive means shall be taken to confine the heat, sparks and slag, and to protect the immovable fire hazards from them.

(3) When welding, cutting or heating is performed on tank shells, decks, overheads and bulkheads, since direct penetration of sparks or heat transfer may introduce a fire hazard to an adjacent compartment, the same precautions shall be taken on the opposite side as are taken on the side on which the welding is being performed.

(4) In order to eliminate the possibility of fire in enclosed spaces as a result of gas escaping through leaking or improperly closed torch valves, the gas supply to the torch shall be positively shut off at some point outside the enclosed space whenever the torch is not to be used or whenever the torch is left unattended for a substantial period of time, such as during the lunch hour. Overnight and at the change of shifts the torch and hose shall be removed from the enclosed space. Open end fuel gas and oxygen hoses shall be immediately removed from enclosed spaces when they are disconnected from the torch or other gas consuming device.

(b) In all cases suitable fire extinguishing equipment shall be immediately available in the work area and shall be maintained in a state of readiness for instant use.

§ 1503.33 Welding, cutting and heating in way of preservative coatings.

(a) Before welding, cutting or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity.

(b) When coatings are determined to be highly flammable either they shall be stripped from the area to be heated to prevent ignition or they shall be burned away under controlled conditions. A 1½-inch or larger fire hose with fog nozzle, which has been uncoiled and placed under pressure, shall be immediately available for instant use in the immediate vicinity, consistent with avoiding freezing of the hose.

(c) Protection against toxic preservative coatings. (1) In enclosed spaces all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least 4 inches from the area of heat application or the employees shall be protected by air line respirators meeting the requirements of § 1503.82(a).

(2) In the open air, employees shall be protected by a filter type respirator in accordance with requirements of § 1503.82 (a) and (d).

§ 1503.34 Welding, cutting and heating of hollow metal containers and structures not covered by § 1503.11.

(a) Drums, containers or hollow structures which have contained flammable substances shall, before welding, cutting or heating is undertaken on them, either be filled with water or thoroughly cleaned of such substances and ventilated and tested.

(b) Before heat is applied to a drum, container or hollow structure, a vent or opening shall be provided for the release of any built-up pressure during the application of heat.

(c) Before welding, cutting, heating or brazing is begun on structural voids such as skegs, bilge keels, fair waters, masts, booms, support stanchions, pipe stanchions or railings, a competent person shall inspect the object and, if necessary, test it for the presence of flammable liquids or vapors. If flammable liquids or vapors are present, the object shall be made safe.

(d) Objects such as those listed in paragraph (c) of this section shall also be inspected to determine whether water or other nonflammable liquids are present which, when heated, would build up excessive pressure. If such liquids are determined to be present, the object shall be vented, cooled or otherwise made safe during the application of heat.

(e) Jacketed vessels shall be vented before and during welding, cutting or heating operations in order to release any pressure which may build up during the application of heat.

§ 1503.35 Gas welding and cutting.

(a) *Transporting, moving and storing compressed gas cylinders.* (1) Valve protection caps shall be in place and secure. Oil shall not be used to lubricate protection caps.

(2) When cylinders are hoisted, they shall be secured on a cradle, slingboard or pallet. They shall not be hoisted by means of magnets or choker slings.

(3) Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dropped, struck or permitted to strike each other violently.

(4) When cylinders are transported by vehicle, they shall be secured in position.

(5) Valve protection caps shall not be used for lifting cylinders from one vertical position to another. Bars shall not be used under valves or valve protection caps to pry cylinders loose when frozen. Warm, not boiling, water shall be used to thaw cylinders loose.

(6) Unless cylinders are firmly secured on a special carrier intended for this purpose, regulators shall be removed and valve protection caps put in place before cylinders are moved.

(7) A suitable cylinder truck, chain or other steadying device shall be used to keep cylinders from being knocked over while in use.

(8) When work is finished, when cylinders are empty, or when cylinders are moved at any time, the cylinder valves shall be closed.

(9) Acetylene cylinders shall be kept in an upright position at all times.

(b) *Placing cylinders.* (1) Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag or flame will not reach them. When this is impractical, fire resistant shields shall be provided.

(2) Cylinders shall be placed where they cannot become part of an electrical circuit. Electrodes shall not be struck against a cylinder to strike an arc.

(3) Fuel gas cylinders shall be placed with valve end up whenever they are in use. They shall not be placed in a location where they would be subject to open flame, hot metal or other sources of artificial heat.

(4) Cylinders containing oxygen or acetylene or other fuel gas shall not be taken into confined spaces.

(c) *Treatment of cylinders.* (1) Cylinders, whether full or empty, shall not be used as rollers or supports.

(2) No person other than the gas supplier shall attempt to mix gases in a cylinder. No one except the owner of the cylinder or person authorized by him shall refill a cylinder. No one shall use a cylinder's contents for purposes other than those intended by the supplier. Only cylinders bearing Interstate Commerce Commission identification and inspection markings shall be used.

(3) No damaged or defective cylinder shall be used.

(d) *Use of fuel gas.* The employer shall thoroughly instruct employees in the safe use of fuel gas, as follows:

(1) Before connecting a regulator to a cylinder valve, the valve shall be opened slightly and closed immediately. (This action is generally termed "cracking" and is intended to clear the valve of dust or dirt that might otherwise enter the regulator). The person cracking the valve shall stand to one side of the outlet, not in front of it. The valve of a fuel gas cylinder shall not be cracked where the gas would reach welding work, sparks, flame or other possible sources of ignition.

(2) The cylinder valve shall always be opened slowly to prevent damage to the regulator. To permit quick closing, valves on fuel gas cylinders shall not be opened more than 1½ turns. When a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel gas flow can be shut off quickly in case of an emergency. In the case of manifolded or coupled cylinders, at least one such wrench shall always be available for immediate use. Nothing shall be placed on top of a fuel gas cylinder, when in use, which may damage the safety device or interfere with the quick closing of the valve.

(3) Fuel gas shall not be used from cylinders through torches or other devices which are equipped with shut-off valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.

(4) Before a regulator is removed from a cylinder valve, the cylinder valve shall always be closed and the gas released from the regulator.

(5) If, when the valve on a fuel gas cylinder is opened, there is found to be a leak around the valve stem, the valve shall be closed and the gland nut tightened. If this action does not stop the leak, the use of the cylinder shall be discontinued, and it shall be properly tagged and removed from the vessel. In the event that fuel gas should leak from the cylinder valve rather than from the valve stem and the gas cannot be shut off, the cylinder shall be properly tagged and removed from the vessel. If a regulator attached to a cylinder valve will effectively stop a leak through the valve seat, the cylinder need not be removed from the vessel.

(6) If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the vessel.

(e) *Manifolds.* (1) Manifolds shall bear the name of the substance they

contain in letters at least one (1) inch high which shall be either painted on the manifold or on a sign permanently attached to it.

(2) All manifolds shall be placed in safe and accessible locations.

(3) Manifold hose connections shall be such that hose cannot be interchanged between fuel gases and oxygen manifolds. Adaptors shall not be used to permit the interchange of hose. Manifold hose connections shall be kept free of grease and oil.

(f) *Hose.* (1) Fuel gas hose and oxygen hose shall be easily distinguishable from each other. The contrast may be made by different colors or by surface characteristics readily distinguishable by the sense of touch. Oxygen and fuel gas hoses shall not be interchangable. A single hose having more than one gas passage, a wall failure of which would permit the flow of one gas into the other gas passage, shall not be used.

(2) When parallel sections of oxygen and fuel gas hose are taped together, not more than 4 inches out of 8 inches shall be covered by tape.

(3) All hose carrying acetylene, oxygen, natural or manufactured fuel gas, or any gas or substance which may ignite or enter into combustion or be in any way harmful to employees, shall be inspected at the beginning of each shift. Defective hose shall be removed from service.

(4) Hose which has been subjected to flashback or which shows evidence of severe wear or damage shall be tested to twice the normal pressure to which it is subject, but in no case less than two hundred (200) psi. Defective hose or hose in doubtful condition shall not be used.

(5) Hose couplings shall be of the type that cannot be unlocked or disconnected by means of a straight pull without rotary motion.

(6) Boxes used for the stowage of gas hose shall be ventilated.

(g) *Torch tips.* Clogged torch tip openings shall be cleaned with suitable cleaning wires, drills or other devices designed for such purpose.

(h) *Pressure regulators.* Oxygen and fuel gas regulators including their related gauges shall be in proper working order while in use.

§ 1503.36 Arc welding and cutting.

(a) *Manual electrode holders.* (1) Only manual electrode holders which are specifically designed for arc welding and cutting and are of a capacity capable of safely handling the maximum rated current required by the electrodes shall be used.

(2) Any current carrying parts passing through the portion of the holder which the arc welder or cutter grips in his hand shall be fully insulated against the maximum voltage encountered to ground.

(b) *Welding cables and connectors.* (1) All arc welding and cutting cables shall be of the completely insulated, flexible type, capable of handling the maximum current requirements of the work in progress, taking into account the duty cycle under which the arc welder or cutter is working.

(2) Only cable free from repair or splices for a minimum distance of ten (10) feet from the cable end to which the electrode holder is connected shall be used, except that cables with standard insulated connectors or with splices whose insulating quality is equal to that of the cable are permitted.

(3) When it becomes necessary to connect or splice lengths of cable one to another, substantial insulated connectors of a capacity at least equivalent to that of the cable shall be used. If connections are effected by means of cable lugs, they shall be securely fastened together to give good electrical contact, and the exposed metal parts of the lugs shall be completely insulated.

(4) Cables in poor repair shall not be used. When a cable, other than the cable lead referred to in subparagraph (2) of this paragraph, becomes worn to the extent of exposing bare conductors, the portion thus exposed shall be protected by means of rubber and friction tapes or other equivalent insulation.

(c) *Ground returns and machine grounding.* (1) A ground return cable shall have a safe current carrying capacity equal to or exceeding the specified maximum output capacity of the arc welding or cutting unit which it services. When a single ground return cable services more than one unit, its safe current carrying capacity shall equal or exceed the total specified maximum output capacities of all the units which it services.

(2) Structures or pipe lines, except pipe lines containing gases or flammable liquids or conduits containing electrical circuits, may be used as part of the ground return circuit, provided that the pipe or structure has a current carrying capacity equal to that required by subparagraph (1) of this paragraph.

(3) When a structure or pipe line is employed as a ground return circuit, it shall be determined that the required electrical contact exists at all joints. The generation of an arc, sparks or heat at any point shall cause rejection of the structure as a ground circuit.

(4) When a structure or pipe line is continuously employed as a ground return circuit, all joints shall be bonded, and periodic inspections shall be conducted to ensure that no condition of electrolysis or fire hazard exists by virtue of such use.

(5) The frames of all arc welding and cutting machines shall be grounded either through a third wire in the cable containing the circuit conductor or through a separate wire which is grounded at the source of the current. Grounding circuits, other than by means of the vessel's structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.

(6) All ground connections shall be inspected to ensure that they are mechanically strong and electrically adequate for the required current.

(d) *Operating instructions.* Employers shall instruct employees in the safe means of arc welding and cutting as follows:

(1) When electrode holders are to be left unattended, the electrodes shall be removed and the holders shall be so placed or protected that they cannot make electrical contact with employees or conducting objects.

(2) Hot electrode holders shall not be dipped in water, since to do so may expose the arc welder or cutter to electric shock.

(3) When the arc welder or cutter has occasion to leave his work or to stop work for any appreciable length of time, or when the arc welding or cutting machine is to be moved, the power supply switch to the equipment shall be opened.

(4) Any faulty or defective equipment shall be reported to the supervisor.

(e) *Shielding.* Whenever practicable, all arc welding and cutting operations shall be shielded by noncombustible or flame-proof screens which will protect employees and other persons working in the vicinity from the direct rays of the arc.

Subpart E—Scaffolds, Ladders and Other Working Surfaces

§ 1503.41 Scaffolds or staging.

(a) *General requirements.* (1) All scaffolds and their supports, whether of lumber, steel or other material, shall be capable of supporting the load they are designed to carry with a safety factor of not less than four (4).

(2) All lumber used in the construction of scaffolds shall be spruce, fir, long leaf yellow pine, Oregon pine or wood of equal strength. The use of hemlock, short leaf yellow pine or short fiber lumber is prohibited.

(3) Lumber dimensions as given in this subpart are nominal except where given in fractions of an inch.

(4) All lumber used in the construction of scaffolds shall be sound, straight-grained, free from cross grain, shakes and large, loose or dead knots. It shall also be free from dry rot, large checks, worm holes or other defects which impair its strength or durability.

(5) Scaffolds shall be maintained in a safe and secure condition. Any component of the scaffold which is broken, burned or otherwise defective shall be replaced.

(6) Barrels, boxes, cans, loose bricks or other unstable objects shall not be used for the support of planking intended as scaffolds or working platforms.

(7) No scaffold shall be erected, moved, dismantled or altered except under the supervision of competent persons.

(b) *Horse scaffolds.* (1) The minimum dimensions of lumber used in the construction of horses shall be in accordance with Table E–1 in § 1503.68.

(2) Horses constructed of materials other than lumber shall provide the strength, rigidity, and security required of horses constructed of lumber.

(3) The lateral spread of the legs shall be equal to not less than one-third of the height of the horse.

(4) All horses shall be kept in good repair, and shall be properly secured

when used in staging or in locations where they may be insecure.

(5) Platform planking shall be in accordance with the requirements of paragraph (d) of this section.

(6) Backrails and toeboards shall be in accordance with paragraph (e) of this section.

(c) *Other types of scaffolds.* (1) Scaffolds of a type for which specifications are not contained in this section shall meet the general requirements of paragraphs (a), (d), and (e) of this section, shall be in accordance with recognized principles of design and shall be constructed in accordance with accepted standards covering such equipment.

(d) *Scaffold or platform planking.* (1) Platform planking shall be of not less than 2 x 10 inch lumber. Platform planking shall be straight-grained and free from large or loose knots and may be either rough or dressed.

(2) Platforms of staging shall be not less than two 10 inch planks in width except in such cases as the structure of the vessel or the width of the trestle ladders make it impossible to provide such a width.

(3) Platform planking shall project beyond the supporting members at either end by at least 6 inches but in no case shall project more than 12 inches unless the planks are fastened to the supporting members.

(4) Table E–2 in § 1503.68 shall be used as a guide in determining safe loads for scaffold planks.

(e) *Backrails and toeboards.* (1) Scaffolding, staging, runways, or working platforms which are supported or suspended more than 5 feet above a solid surface, or at any distance above the water, shall be provided with a railing which has a top rail whose upper surface is from 42 to 45 inches above the upper surface of the staging, platform, or runway and a midrail located half-way between the upper rail and the staging, platform, or runway.

(2) Rails shall be of 2 x 4 inch lumber, flat bar or pipe. When used with rigid supports, taut wire or fiber rope of adequate strength may be used. If the distance between supports is more than 8 feet, rails shall be equivalent in strength to 2 x 4 inch lumber. Rails shall be firmly secured.

(3) Rails may be omitted where the structure of the vessel prevents their use. When rails are omitted employees working more than 5 feet above solid surfaces shall be protected by safety belts and life lines meeting the requirements of § 1503.84(b), and employees working over water shall be protected by buoyant working vests meeting the requirements of § 1503.84(a).

(4) Employees working from scaffolds on floats subject to surging, shall be protected against falling toward the vessel by a railing or a safety belt and line attached to the backrail.

(5) When necessary, to prevent tools and materials from falling on men below, toeboards of not less than 1 x 4 inch lumber shall be provided.

(f) *Access to staging.* (1) Access to staging more than 5 feet above a floor, deck or the ground shall consist of well secured stairways, cleated ramps, fixed or portable ladders meeting the applicable requirements of § 1503.42 or rigid type non-collapsible trestles with parallel and level rungs.

(2) Ramps and stairways shall be provided with 36-inch handrails with midrails.

(3) Ladders shall be so located or other means shall be taken so that it is not necessary for employees to step more than one foot from the ladder to any intermediate landing or platform.

(4) Ladders forming integral parts of prefabricated staging are deemed to meet the requirements of these regulations.

(5) Access from above to staging more than 3 feet below the point of access shall consist of a straight, portable ladder meeting the applicable requirements of § 1503.42 or a Jacob's ladder properly secured, meeting the requirements of § 1503.44(d).

§ 1503.42 Ladders.

(a) *General requirements.* (1) The use of ladders with broken or missing rungs or steps, broken or split side rails, or other faulty or defective construction is prohibited. When ladders with such defects are discovered, they shall be immediately withdrawn from service. Inspection of metal ladders shall include checking for corrosion of interiors of open end, hollow rungs.

(2) When sections of ladders are spliced, the ends shall be abutted, and not fewer than 2 cleats shall be securely nailed or bolted to each rail. The combined cross sectional area of the cleats shall be not less than the cross sectional area of the side rail. The dimensions of side rails for their total length shall be those specified in paragraph (b) or (c) of this section.

(3) Portable ladders shall be lashed, blocked or otherwise secured to prevent their being displaced. The side rails of ladders used for access to any level shall extend not less than 36 inches above that level. When this is not practical, grab rails which will provide a secure grip for an employee moving to or from the point of access shall be installed.

(4) Portable metal ladders shall be of strength equivalent to that of wood ladders. Manufactured portable metal ladders provided by the employer shall be in accordance with the provisions of the American Standard Safety Code for Portable Metal Ladders, A14.2.

(5) Portable metal ladders shall not be used near electrical conductors nor for electric arc welding operations.

(6) Manufactured portable wood ladders provided by the employer shall be in accordance with the provisions of the American Standard Safety Code for Portable Wood Ladders, A14.1.

(b) *Construction of portable wood cleated ladders up to 30 feet in length.* (1) Wood side rails shall be made from West Coast hemlock, Eastern spruce, Sitka spruce, or wood of equivalent strength. Material shall be seasoned, straight-grained wood, and free from shakes, checks, decay or other defects which will impair its strength. The use of low density woods is prohibited.

(2) Side rails shall be dressed on all sides, and kept free of splinters.

(3) All knots shall be sound and hard. The use of material containing loose knots is prohibited. Knots shall not appear on the narrow face of the rail and, when in the side face, shall be not more than ½ inch in diameter or within ½ inch of the edge of the rail or nearer than 3 inches to a tread or rung.

(4) Pitch pockets not exceeding ⅛ inch in width, 2 inches in length and ½ inch in depth are permissible in wood side rails, provided that not more than one such pocket appears in each 4 feet of length.

(5) The width between side rails at the base shall be not less than 11½ inches for ladders 10 feet or less in length. For longer ladders this width shall be increased at least ¼ inch for each additional 2 feet of length.

(6) Side rails shall be at least 1⅝ x 3⅝ inches in cross section.

(7) Cleats (meaning rungs rectangular in cross section with the wide dimension parallel to the rails) shall be of the material used for side rails, straight-grained and free from knots. Cleats shall be mortised into the edges of the side rails ½ inch, or filler blocks shall be used on the rails between the cleats. The cleats shall be secured to each rail with three 10d common wire nails or fastened with through bolts or other fasteners of equivalent strength. Cleats shall be uniformly spaced not more than 12 inches apart.

(8) Cleats 20 inches or less in length shall be at least $^{25}/_{32}$ x 3 inches in cross section. Cleats over 20 inches but not more than 30 inches in length shall be at least $^{25}/_{32}$ x 3¾ inches in cross section.

(c) *Construction of portable wood cleated ladders from 30 to 60 feet in length.* (1) Ladders from 30 to 60 feet in length shall be in accordance with the specifications of paragraph (b) of this section with the following exceptions:

(i) Rails shall be of not less than 2 x 6 inch lumber.

(ii) Cleats shall be of not less than 1 x 4 inch lumber.

(iii) Cleats shall be nailed to each rail with five 10d common wire nails or fastened with through bolts or other fastenings of equivalent strength.

§ 1503.43 [Reserved]

§ 1503.44 Access to vessels.

(a) *Access to vessels afloat.* The employer shall not permit employees to board or leave any vessel, except a barge or river towboat, until the following requirements have been met:

(1) Whenever practicable, a gangway of not less than 20 inches walking surface, of adequate strength, maintained in safe repair and safely secured shall be used. If a gangway is not practicable, a substantial straight ladder, extending at least 36 inches above the upper landing surface and adequately secured against shifting or slipping shall be provided. In an emergency a Jacob's ladder meeting the requirements of paragraph (d) (1) and (2) of this section may be used.

(2) Each side of such gangway, and the turn table if used, shall have a rail-

ing with a minimum height of approximately 33 inches measured perpendicularly from rail to walking surface at the stanchion, with a midrail. Rails shall be of wood, pipe, chain, wire, or rope and shall be kept taut at all times.

(3) The gangway shall be kept properly trimmed at all times.

(4) When a fixed tread accommodation ladder is used, and the angle is low enough to require employees to walk on the edge of the treads, cleated duckboards shall be laid over and secured to the ladder.

(5) When the lower end of a gangway overhangs the water between the ship and the dock in such a manner that there is danger of employees falling between the ship and the dock, a net or other suitable protection shall be rigged at the foot of the gangway in such a manner as to prevent employees from falling from the end of the gangway.

(6) If the foot of the gangway is more than one foot away from the edge of the apron, the space between them shall be bridged by a firm walkway equipped with railings, with a minimum height of approximately 33 inches with midrails on both sides.

(7) Supporting bridles shall be kept clear so as to permit unobstructed passage for employees using the gangway.

(8) When the upper end of the means of access rests on or flush with the top of the bulwark, substantial steps properly secured and equipped with at least one substantial handrail approximately 33 inches in height shall be provided between the top of the bulwark and the deck.

(9) Obstructions shall not be laid on or across the gangway.

(10) The means of access shall be adequately illuminated for its full length.

(11) Loads shall not be passed over the means of access while employees are on it.

(b) *Access to vessels in drydock or between vessels.* Gangways meeting the requirements of paragraph (a) (1), (2), (8), (9) and (10) of this section shall be provided for access from wing wall to vessel or, when two or more vessels, other than barges or river towboats, are lying abreast, from one vessel to another.

(c) *Access to barges and river towboats.* (1) Ramps for access of vehicles to or between barges shall be of adequate strength, provided with side boards, well maintained and properly secured.

(2) Unless employees can step safely to or from the wharf, float, barge, or river towboat, either a ramp in accordance with the requirements of subparagraph (1) of this paragraph or a safe walkway in accordance with the requirements of paragraph (a) (6) of this section shall be provided. When a walkway is impracticable, a substantial straight ladder, extending at least 36 inches above the upper landing surface and adequately secured against shifting or slipping shall be provided. In an emergency a Jacob's ladder in accordance with the requirements of paragraph (d) of this section may be used.

(3) The means of access shall be in accordance with the requirements of paragraph (a) (8), (9) and (10) of this section.

(d) *Jacob's ladders.* (1) Jacob's ladders shall be of the double rung or flat tread type. They shall be well maintained and properly secured.

(2) A Jacob's ladder shall either hang without slack from its lashings or be pulled up entirely.

§ 1503.45 Access to and guarding of dry docks.

(a) A gangway, ramp or permanent stairway of not less than 20 inches walking surface, of adequate strength, maintained in safe repair and securely fastened, shall be provided between a floating dry dock and the pier or bulkhead.

(b) Each side of such gangway, ramp or permanent stairway, including those which are used for access to wing walls from dry dock floors, shall have a railing with a midrail. Such railings on gangways or ramps shall be approximately 42 inches in height; and railings on permanent stairways shall be not less than approximately 30 or more than approximately 34 inches in height. Rails shall be of wood, pipe, chain, wire, or rope and shall be kept taut at all times.

(c) Railings meeting the requirements of paragraph (b) of this section shall be provided on the means of access to and from the floors of graving docks.

(d) Railings approximately 42 inches in height, with a midrail, shall be provided on the edges of wing walls of floating dry docks and on the edges of graving docks. Sections of the railings may be temporarily removed where necessary to permit line handling while a vessel is entering the dock.

(e) When employees are working on the floor of a floating dry dock where they are exposed to the hazard of falling into the water, the end of the dry dock shall be equipped with portable stanchions and 42-inch railings with a mid rail. When such a railing would be impracticable or ineffective, other effective means shall be provided to prevent men from falling into the water.

(f) Access to wingwalls from floors of dry docks shall be by ramps, permanent stairways or ladders meeting the applicable requirements of § 1503.42.

§ 1503.46 Access to cargo and confined spaces.

(a) *Cargo spaces.* (1) There shall be at least one safe and accessible ladder in any cargo space which employees must enter.

(2) When any fixed ladder is visibly unsafe, the employer shall prohibit its use by employees.

(3) Straight ladders of adequate strength and suitably secured against shifting or slipping shall be provided as necessary when fixed ladders in cargo spaces do not meet the requirements of subparagraph (1) of this paragraph. In an emergency a Jacob's ladder meeting the requirements of § 1503.44(d) may be used.

(4) Fixed ladders or straight ladders provided for access to cargo spaces shall not be used at the same time that equipment, materials, scrap or other loads are entering or leaving the hold. Before using these ladders to enter or leave the hold, the employee shall be required to inform the winchman or crane signalman of his intention.

(b) *Confined spaces.* (1) More than one means of access shall be provided to a confined space in which employees are working and in which the work may generate a hazardous atmosphere.

(2) When the ventilating ducts required by these regulations must pass through these means of access an additional means of access shall be provided.

Subpart F—General Working Conditions

§ 1503.51 Housekeeping.

(a) All working areas on or immediately surrounding the vessel in a dry dock and graving dock or on a marine railway shall be kept in a reasonable state of order. Scrap, equipment and other materials shall be so piled as not to present a hazard to employees.

(b) Adequate aisles and passageways shall be maintained, as far as practicable, in all work areas, except when impossible due to the nature of the work being performed.

(c) Free access shall be maintained at all times to all exits and to fire-extinguishing equipment.

§ 1503.52 Illumination.

(a) All means of access and walkways leading to working areas as well as the working areas themselves shall be adequately illuminated.

(b) Temporary lights shall meet the following requirements:

(1) Temporary lights shall be equipped with guards to prevent accidental contact with the bulb, except that guards are not required when the construction of the reflector is such that the bulb is deeply recessed.

(2) Temporary lights shall be equipped with heavy duty electric cords with connections and insulation maintained in safe condition. Temporary lights shall not be suspended by their electric cords unless cords and lights are designed for this means of suspension.

(3) Cords shall be kept clear of working spaces and walkways or other locations in which they are readily exposed to damage.

(c) Exposed non-current-carrying metal parts of temporary lights furnished by the employer shall be grounded either through a third wire in the cable containing the circuit conductors or through a separate wire which is grounded at the source of the current. Grounding shall be in accordance with the requirements of § 1503.72(b).

(d) Where temporary lighting from sources outside the vessel is the only means of illumination, portable emergency lighting equipment shall be available to provide illumination for safe movement of employees.

(e) Employees shall not be permitted to enter dark spaces without a suitable portable light. The use of matches and open flame lights is prohibited. In non-gas free spaces, portable lights shall meet the requirements of § 1503.12(b).

(f) Temporary lighting stringers or streamers shall be so arranged as to avoid overloading of branch circuits. Each

branch circuit shall be equipped with overcurrent protection of capacity not exceeding the rated current carrying capacity of the cord used.

§ 1503.53 Utilities.

(a) *Steam supply and hoses.* (1) Prior to supplying a vessel with steam from a source outside the vessel, the employer shall ascertain the safe working pressure of the vessel's steam system. The employer shall install a pressure gauge and a relief valve of proper size and capacity at the point where the temporary steam hose joins the vessel's steam piping system or systems. The relief valve shall be set and capable of relieving at a pressure not exceeding the safe working pressure of the vessel's system in its present condition, and there shall be no means of isolating the relief valve from the system which it protects. The pressure gauge and relief valve shall be located so as to be visible and readily accessible.

(2) Steam hose fittings shall have a safety factor of not less than five (5).

(3) When steam hose is hung in a bight or bights, the weight shall be relieved by appropriate lines. The hose shall be protected against chafing.

(4) Steam hose shall be protected from damage and hose and temporary piping shall be so shielded where passing through normal work areas as to prevent accidental contact by employees.

(b) *Electric power.* (1) When the vessel is supplied with electric power from a source outside the vessel, the following precautions shall be taken prior to energizing the vessel's circuits:

(i) If in dry dock, the vessel shall be adequately grounded.

(ii) The employer shall ensure that all circuits to be energized are in a safe condition.

(iii) All circuits to be energized shall be equipped with overcurrent protection of capacity not exceeding the rated current carrying capacity of the cord used.

§ 1503.54 Work in confined or isolated spaces.

When any work is performed in a confined space, except as provided in § 1503.31(b)(3), or when an employee is working alone in an isolated location, frequent checks shall be made to ensure the safety of the employees.

§ 1503.55 [Reserved]

§ 1503.56 Work in or on lifeboats.

(a) Before employees are permitted to work in or on a lifeboat, either stowed or in a suspended position, the employer shall ensure that the boat is secured independently of the releasing gear to prevent the boat from falling due to accidental tripping of the releasing gear and movement of the davits or capsizing of a boat in chocks.

(b) Employees shall not be permitted to work on the outboard side of lifeboats stowed on their chocks unless the boats are secured by gripes or otherwise secured to prevent them from swinging outboard.

§ 1503.57 Health and sanitation.

(a) The employer shall provide adequate washing facilities for employees engaged in the various shipbreaking operations where contaminants can, by ingestion or absorption, be detrimental to the health of the employee. The employer shall encourage good personal hygiene practices by informing the employees of the need for removing surface contaminants by thorough washing of hands and face prior to eating or smoking.

(b) The employer shall not permit eating or smoking in the immediate areas where shipbreaking operations produce atmospheric contaminants.

(c) No minor under 18 years of age shall be employed in shipbreaking or related employments.

§ 1503.58 First aid.

(a) Unless a first aid room and a qualified attendant are close at hand and prepared to render first aid to employees on behalf of the employer, the employer shall furnish a first aid kit for each vessel on which work is being performed, except that when work is being performed on more than one small vessel at one pier, only one kit shall be required. The kit, when required, shall be kept close to the vessel and at least one employee, close at hand, shall be qualified to administer first aid to the injured.

(b) The first aid kit shall consist of a weatherproof container with individual sealed packages for each type of item. The contents of such kit shall contain a sufficient quantity of at least the following types of items:

Gauze roller bandages, 1 inch and 2 inch.
Gauze compress bandages, 4 inch.
Adhesive bandages, 1 inch.
Triangular bandage, 40 inch.
Ammonia inhalants and ampules.
Antiseptic applicators or swabs.
Burn dressing.
Eye dressing.
Wire or thin board splints.
Forceps and tourniquet.

(c) The contents of the first aid kit shall be checked before being sent out on each job, and at least weekly on each job, to ensure that the expended items are replaced.

(d) There shall be available for each vessel one Stokes basket stretcher, or equivalent, permanently equipped with bridles for attaching to the hoisting gear, except that no more than two stretchers are required on each job location. Stretchers shall be kept close to the vessels. This paragraph does not apply where ambulance services carry such stretchers.

Subpart G—Gear and Equipment for Rigging and Materials Handling

§ 1503.61 Inspection.

(a) All gear and equipment provided by the employer for rigging and materials handling shall be inspected before each shift and, when necessary, at intervals during its use to ensure that it is safe. Defective gear shall be removed and repaired or replaced before further use.

(b) The safe working load of gear as specified in §§ 1503.62 and 1503.63 shall not be exceeded.

§ 1503.62 Ropes, chains and slings.

(a) *Manila rope and manila rope slings.* Table G–1 in § 1503.68 shall be used to determine the safe working load of various sizes of manila rope and manila rope slings at various angles, except that higher safe working loads are permissible when recommended by the manufacturer for specific, identifiable products, provided that a safety factor of not less than five (5) is maintained.

(b) *Wire rope and wire rope slings.* (1) Tables G–2 through G–5 in § 1503.68 shall be used to determine the safe working loads of various sizes and classifications of improved plow steel wire rope and wire rope slings with various types of terminals. For sizes, classifications and grades not included in these tables, the safe working load recommended by the manufacturer for specific, identifiable products shall be followed, provided that a safety factor of not less than five (5) is maintained.

(2) Protruding ends of strands in splices on slings and bridles shall be covered or blunted.

(3) Where U-bolt wire rope clips are used to form eyes, Table G–6 in § 1503.68 shall be used to determine the number and spacing of clips. The U-bolt shall be applied so that the "U" section is in contact with the dead end of the rope.

(4) Wire rope shall not be secured by knots.

(c) *Chains and chain slings.* (1) Tables G–7 and G–8 in § 1503.68 shall be used to determine the working load limit of various sizes of wrought iron and alloy steel chains and chain slings, except that higher safe working loads are permissible when recommended by the manufacturer for specific, identifiable products.

(2) All sling chains, including end fastenings, shall be given a visual inspection before being used on the job. A thorough inspection of all chains in use shall be made every 3 months. Each chain shall bear an indication of the month in which it was thoroughly inspected. The thorough inspection shall include inspection for wear, defective welds, deformation and increase in length or stretch.

(3) Interlink wear, not accompanied by stretch in excess of 5 percent, shall be noted and the chain removed from service when maximum allowable wear at any point of link, as indicated in Table G–9 in § 1503.68, has been reached.

(4) Chain slings shall be removed from service when, due to stretch, the increase in length of a measured section exceeds five (5) percent; when a link is bent, twisted or otherwise damaged; or when raised scarfs or defective welds appear.

(5) All repairs to chains shall be made under qualified supervision. Links or portions of the chain found to be defective as described in paragraph (d) of this section shall be replaced by links having proper dimensions and made of material similar to that of the chain. Before repaired chains are returned to service, they shall be proof tested to the proof test load recommended by the manufacturer.

(6) Wrought iron chains in constant use shall be annealed or normalized at intervals not exceeding six months when recommended by the manufacturer. The chain manufacturer shall be consulted

for recommended procedures for annealing or normalizing. Alloy chains shall never be annealed.

(7) A load shall not be lifted with a chain having a kink or knot in it. A chain shall not be shortened by bolting, wiring or knotting.

§ 1503.63 Shackles and hooks.

(a) *Shackles.* (1) Table G–10 in § 1503.68 shall be used to determine the safe working loads of various sizes of shackles, except that higher safe working loads are permissible when recommended by the manufacturer for specific, identifiable products, provided that a safety factor of not less than five (5) is maintained.

(b) *Hooks.* (1) The manufacturer's recommendations shall be followed in determining the safe working loads of the various sizes and types of specific and identifiable hooks. All hooks for which no applicable manufacturer's recommendations are available shall be tested to twice the intended safe working load before they are initially put into use. The employer shall maintain a record of the dates and results of such tests.

(2) Loads shall be applied to the throat of the hook since loading the point overstresses and bends or springs the hook.

(3) Hooks shall be inspected periodically to see that they have not been bent by overloading. Bent or sprung hooks shall not be used.

§ 1503.64 Chain falls and pull-lifts.

(a) Chain falls and pull-lifts shall be clearly marked to show the capacity and the capacity shall not be exceeded.

(b) Chain falls shall be regularly inspected to ensure that they are safe, particular attention being given to the lift chain, pinion, sheaves and hooks for distortion and wear. Pull-lifts shall be regularly inspected to ensure that they are safe, particular attention being given to the ratchet, pawl, chain and hooks for distortion and wear.

(c) Straps, shackles, and the beam or overhead structure to which a chain fall or pull-lift is secured shall be of adequate strength to support the weight of load plus gear. The upper hook shall be moused or otherwise secured against coming free of its support.

§ 1503.65 Hoisting and hauling equipment.

(a) The moving parts of hoisting and hauling equipment shall be guarded.

(b) Mobile crawler or truck cranes used on a vessel:

(1) The maximum manufacturer's rated safe working loads for the various working radii of the boom and the maximum and minimum radii at which the boom may be safely used with and without outriggers shall be conspicuously posted near the controls and shall be visible to the operator. A radius indicator shall be provided.

(2) The posted safe working loads of mobile crawler or truck cranes under the conditions of use shall not be exceeded.

(3) The area within the swing radius of the body of a crawler or truck crane and the extended parts thereof shall be guarded in such a manner as to prevent an employer from being in such a position as to be struck by the crane or caught between the crane and fixed parts of the vessel or of the crane itself.

(c) Marine railways:

(1) The cradle or carriage on the marine railway shall be positively blocked or secured when in the hauled position to prevent it from being accidentally released.

§ 1503.66 Use of gear.

(a) Loads shall be safely rigged before being hoisted.

(b) When slings are secured to eyebolts, the slings shall be so arranged, using spreaders if necessary, that the pull is within 20 degrees of the axis of the bolt.

(c) Slings shall be padded by means of wood blocks or other suitable material where they pass over sharp edges or corners of loads so as to prevent cutting or kinking.

(d) Skips shall be rigged to be handled by not less than 3 legged bridles, and all legs shall always be used. When open end skips are used, means shall be taken to prevent the contents from falling.

(e) Loose ends of idle legs of slings in use shall be hung on the hook.

(f) Employees shall not be permitted to ride the hook or the load.

(g) Loads (tools, equipment or other materials) shall not be swung or suspended over the heads of employees.

(h) Pieces of equipment or structure susceptible to falling or dislodgement shall be secured or removed as early as possible.

(i) An individual who is familiar with the signal code in use shall be assigned to act as a signalman when the hoist operator cannot see the load being handled. Communications shall be made by means of clear and distinct visual or auditory signals except that verbal signals shall not be permitted.

(j) Pallets, when used, shall be of such material and construction and so maintained as to safely support and carry the loads being handled on them.

(k) Before loads or empty lifting gear are raised, lowered, or swung, clear and sufficient advance warning shall be given to employees in the vicinity of such operations.

(l) At no time shall an employee be permitted to place himself in a hazardous position between a swinging load and a fixed object.

(m) A section of hatch through which materials or equipment are being raised, lowered, moved or otherwise shifted by a crane, winch, hoist or derrick, shall be completely opened. The beams and pontoons left in place adjacent to an opening shall be sufficiently lashed, locked or otherwise secured to prevent them from being unshipped.

§ 1503.67 Qualifications of operators.

(a) Only those employees who understand the signs, notices, and operating instructions, and are familiar with the signal code in use, shall be permitted to operate a crane, winch, or other power operated hoisting apparatus.

(b) No employee known to have defective uncorrected eyesight or hearing, or to be suffering from heart disease, epilepsy, or similar ailment which may suddenly incapacitate him, shall be permitted to operate a crane, winch or other power operated hoisting apparatus.

§ 1503.68 Tables.

TABLE E–1

SPECIFICATIONS FOR THE CONSTRUCTION OF HORSES

Structural members	Height in feet		
	Up to 10	10 to 16	16 to 20
	Inches	*Inches*	*Inches*
Legs	2 x 4	3 x 4	4 x 6
Bearers or headers	2 x 6	2 x 8	4 x 6
Crossbraces	2 x 4 or 1 x 8	2 x 4	2 x 6
Longitudinal braces	2 x 4	2 x 6	2 x 6

TABLE E–2

SAFE CENTER LOADS FOR SCAFFOLD PLANK OF 1,100 POUNDS FIBRE STRESS

Span in feet	Lumber dimensions in inches									
	A	B	A	B	A	B	A	B	A	B
	2 x 10	1⅝ x 9¼	2 x 12	1⅝ x 11¼	3 x 8	2⅝ x 7¼	3 x 10	2⅝ x 9¼	3 x 12	2⅝ x 11¼
6	256		309		526		667		807	
8	192		232		395		500		605	
10	153		186		316		400		484	
12	128		155		263		333		404	
14	110		133		225		286		346	
16	-------		116		197		250		303	

(A)—Rough lumber.
(B)—Dressed lumber.

TABLE G-1
MANILA ROPE
(In pounds or tons of 2000 pounds)

Circumference	Diameter in Inches	Single Leg	60°	45°	30°
3/4	1/4	120 lbs.	204 lbs.	170 lbs.	120 lbs.
1	5/16	200	346	282	200
1-1/8	3/8	270	467	380	270
1-1/4	7/16	350	605	493	350
1-3/8	15/32	450	775	635	450
1-1/2	1/2	530	915	798	530
1-3/4	9/16	690	1190	973	690
2	5/8	880	1520	1240	880
2-1/4	3/4	1080	1870	1520	1080
2-1/2	13/16	1300	2250	1830	1300
2-3/4	7/8	1540	2660	2170	1540
3	1	1800	3120	2540	1800
3-1/4	1-1/16	1.0 Tons	1.7 Tons	1.4 Tons	1.0 Tons
3-1/2	1-1/8	1.2	2.1	1.7	1.2
3-3/4	1-1/4	1.35	2.3	1.9	1.35
4	1-5/16	1.5	2.6	2.1	1.5
4-1/2	1-1/2	1.8	3.1	2.5	1.8
5	1-5/8	2.25	3.9	3.2	2.25
5-1/2	1-3/4	2.6	4.5	3.7	2.6
6	2	3.1	5.4	4.4	3.1
6-1/2	2-1/8	3.6	6.2	5.1	3.6

TABLE G-2

RATED CAPACITIES FOR IMPROVED PLOW STEEL, INDEPENDENT WIRE ROPE CORE, WIRE ROPE AND WIRE ROPE SLINGS

(In tons of 2000 pounds)

Rope Dia. Inches	SINGLE LEG					
	Vertical			Choker		
	A	B	C	A	B	C
6x19 CLASSIFICATION						
1/4"	.59	.56	.53	.44	.42	.40
3/8"	1.3	1.2	1.1	.98	.93	.86
1/2"	2.3	2.2	2.0	1.7	1.6	1.5
5/8"	3.6	3.4	3.0	2.7	2.5	2.2
3/4"	5.1	4.9	4.2	3.8	3.6	3.1
7/8"	6.9	6.6	5.5	5.2	4.9	4.1
1"	9.0	8.5	7.2	6.7	6.4	5.4
1-1/8"	11.	10.	9.0	8.5	7.8	6.8
6x37 CLASSIFICATION						
1-1/4"	13.	12.	10.	9.9	9.2	7.9
1-3/8"	16.	15.	13.	12.	11.	9.6
1-1/2"	19.	17.	15.	14.	13.	11.
1-3/4"	26.	24.	20.	19.	18.	15.
2"	33.	30.	26.	25.	23.	20.
2-1/4"	41.	38.	33.	31.	29.	25.

(A) - Socket or Swaged Terminal attachment.
(B) - Mechanical Sleeve attachment.
(C) - Hand Tucked Splice attachment.

TABLE G-3

RATED CAPACITIES FOR IMPROVED PLOW STEEL INDEPENDENT WIRE ROPE CORE, WIRE ROPE SLINGS

(In tons of 2000 pounds)

TWO - LEG BRIDLE OR BASKET HITCH												
Rope Dia. Inches	Vertical			60°			45°			30°		
	A	B	C	A	B	C	A	B	C	A	B	C
6x19 CLASSIFICATION												
1/4"	1.2	1.1	1.0	1.0	.97	.92	.83	.79	.75	.59	.56	.53
3/8"	2.6	2.5	2.3	2.3	2.1	2.0	1.8	1.8	1.6	1.3	1.2	1.1
1/2"	4.6	4.4	3.9	4.0	3.8	3.4	3.2	3.1	2.8	2.3	2.2	2.0
5/8"	7.2	6.8	6.0	6.2	5.9	5.2	5.1	4.8	4.2	3.6	3.4	3.0
3/4"	10.	9.7	8.4	8.9	8.4	7.3	7.2	6.9	5.9	5.1	4.9	4.2
7/8"	14.	13.	11.	12.	11.	9.6	9.8	9.3	7.8	6.9	6.6	5.5
1"	18.	17.	14.	15.	15.	12.	13.	12.	10.	9.0	8.5	7.2
1-1/8"	23.	21.	18.	19.	18.	16.	16.	15.	13.	11.	10.	9.0
6x37 CLASSIFICATION												
1-1/4"	26.	24.	21.	23.	21.	18.	19.	17.	15.	13.	12.	10.
1-3/8"	32.	29.	25.	28.	25.	22.	22.	21.	18.	16.	15.	13.
1-1/2"	38.	35.	30.	33.	30.	26.	27.	25.	21.	19.	17.	15.
1-3/4"	51.	47.	41.	44.	41.	35.	36.	33.	29.	26.	24.	20.
2"	66.	61.	53.	57.	53.	46.	47.	43.	37.	33.	30.	26.
2-1/4"	83.	76.	66.	72.	66.	57.	58.	54.	47.	41.	38.	33.

(A) - Socket or Swaged Terminal Attachment.
(B) - Mechanical Sleeve Attachment.
(C) - Hand Tucked Splice Attachment.

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TABLE G-4

RATED CAPACITIES FOR IMPROVED PLOW STEEL, FIBER CORE, WIRE ROPE AND WIRE ROPE SLINGS

(In tons of 2000 pounds)

Rope Dia. Inches	SINGLE LEG					
	Vertical			Choker		
	A	B	C	A	B	C
6x19 CLASSIFICATION						
1/4	.55	.51	.49	.41	.38	.37
3/8	1.2	1.1	1.1	.91	.85	.80
1/2	2.1	2.0	1.8	1.6	1.5	1.4
5/8	3.3	3.1	2.8	2.5	2.3	2.1
3/4	4.8	4.4	3.9	3.6	3.3	2.9
7/8	6.4	5.9	5.1	4.8	4.5	3.9
1	8.4	7.7	6.7	6.3	5.8	5.0
1-1/8	10.	9.5	8.4	7.9	7.1	6.3
6x37 CLASSIFICATION						
1-1/4	12.	11.	9.8	9.2	8.3	7.4
1-3/8	15.	13.	12.	11.	10.	8.9
1-1/2	17.	16.	14.	13.	12.	10.
1-3/4	24.	21.	19.	18.	16.	14.
2	31.	28.	25.	23.	21.	18.

(A) - Socket or Swaged Terminal attachment.
(B) - Mechanical Sleeve attachment.
(C) - Hand Tucked Splice attachment.

TABLE G-5
RATED CAPACITIES FOR IMPROVED PLOW STEEL, FIBER CORE, WIRE ROPE SLINGS
(In tons of 2000 pounds)

Rope Dia. Inches	TWO - LEG BRIDLE OR BASKET HITCH											
	Vertical			60°			45°			30°		
	A	B	C	A	B	C	A	B	C	A	B	C
6x19 CLASSIFICATION												
1/4	1.1	1.0	.99	.95	.88	.85	.77	.72	.70	.55	.51	.49
3/8	2.4	2.2	2.1	2.1	1.9	1.8	1.7	1.6	1.5	1.2	1.1	1.1
1/2	4.3	3.9	3.7	3.7	3.4	3.2	3.0	2.8	2.6	2.1	2.0	1.8
5/8	6.7	6.2	5.6	5.8	5.3	4.8	4.7	4.4	4.0	3.3	3.1	2.8
3/4	9.5	8.8	7.8	8.2	7.6	6.8	6.7	6.2	5.5	4.8	4.4	3.9
7/8	13.	12.	10.	11.	10.	8.9	9.1	8.4	7.3	6.4	5.9	5.1
1	17.	15.	13.	14.	13.	11.	12.	11.	9.4	8.4	7.7	6.7
1-1/8	21.	19.	17.	18.	16.	14.	15.	13.	12.	10.	9.5	8.4
6x37 CLASSIFICATION												
1-1/4	25.	22.	20.	21.	19.	17.	17.	16.	14.	12.	11.	9.8
1-3/8	30.	27.	24.	26.	23.	20.	21.	19.	17.	15.	13.	12.
1-1/2	35.	32.	28.	30.	27.	24.	25.	22.	20.	17.	16.	14.
1-3/4	48.	43.	38.	41.	37.	33.	34.	30.	27.	24.	21.	19.
2	62.	55.	49.	53.	48.	43.	43.	39.	35.	31.	28.	25.

(A) - Socket or Swaged Terminal attachment.
(B) - Mechanical Sleeve attachment.
(C) - Hand Tucked Splice attachment.

TABLE G-6

NUMBER AND SPACING OF U-BOLT WIRE ROPE CLIPS

Improved plow steel, rope diameter (inches)	Number of clips		Minimum spacing (inches)
	Drop forged	Other material	
1/4	3	4	3
5/16	3	4	3 3/4
3/8	4	5	4 1/2
7/16	4	5	5 1/4
1/2	4	6	6
9/16	5	6	6 3/4
5/8	5	7	7 1/2
3/4	6	7	8 1/4
7/8	6	8	9

TABLE G-7
WROUGHT IRON CHAIN
(In pounds or tons of 2000 pounds)

Nominal Size Chain Stock Inch.	Single Leg	60°	45°	30°
* 1/4	1060	1835	1500	1060
* 5/16	1655	2865	2340	1655
3/8	2385	2.1	3370	2385
* 7/16	3250	2.8	2.3	3250
1/2	2.1	3.7	3.0	2.1
* 9/16	2.7	4.6	3.8	2.7
5/8	3.3	5.7	4.7	3.3
3/4	4.8	8.3	6.7	4.8
7/8	6.5	11.2	9.2	6.5
1	8.5	14.7	12.0	8.5
1-1/8	10.0	17.3	14.2	10.0
1-1/4	12.4	21.4	17.5	12.4
1-3/8	15.0	25.9	21.1	15.0
1-1/2	17.8	30.8	25.2	17.8
1-5/8	20.9	36.2	29.5	20.9
1-3/4	24.2	42.0	34.3	24.2
1-7/8	27.6	47.9	39.1	27.6
2	31.6	54.8	44.8	31.6

* These sizes of wrought iron chain are no longer manufactured in the United States.

TABLE G-8
ALLOY STEEL CHAIN
(In tons of 2000 pounds)

Nominal Size Chain Stock Inch.	Single Leg	60°	45°	30°
1/4	1.62	2.82	2.27	1.62
3/8	3.30	5.70	4.65	3.30
1/2	5.62	9.75	7.90	5.62
5/8	8.25	14.25	11.65	8.25
3/4	11.5	19.9	16.2	11.5
7/8	14.3	24.9	20.3	14.3
1	19.3	33.5	27.3	19.8
1-1/8	22.2	38.5	31.5	22.2.
1-1/4	28.7	49.7	40.5	28.7
1-3/8	33.5	58.0	47.0	33.5
1-1/2	39.7	68.5	56.0	39.7
1-5/8	42.5	73.5	59.5	42.5
1-3/4	47.0	81.5	62.0	47.0

TABLE G-9

MAXIMUM ALLOWABLE WEAR AT ANY POINT OF LINK

Chain size in inches	Maximum allowable wear in fraction of inches
¼ (9/32)	3/64
5/16	5/64
3/8	7/64
7/16	9/64
1/2	5/32
9/16	11/64
5/8	3/16
11/16	7/32
3/4	1/4
13/16	9/32
7/8	5/16
15/16	11/32

TABLE G-10

SAFE WORKING LOADS FOR SHACKLES
(In tons of 2,000 pounds)

Material size (inches)	Pin diameter (inches)	Safe working load
1/2	5/8	1.4
5/8	3/4	2.2
3/4	7/8	3.2
7/8	1	4.3
1	1 1/8	5.6
1 1/8	1 1/4	6.7
1 1/4	1 3/8	8.2
1 3/8	1 1/2	10.0
1 1/2	1 5/8	11.9
1 3/4	2	16.2
2	2 1/4	21.2

TABLE I-1

FILTER LENSES FOR PROTECTION AGAINST RADIANT ENERGY

Operation	Shade No.
Soldering	2
Torch Brazing	3 or 4
Light cutting, up to 1 inch	3 or 4
Medium cutting, 1-6 inches	4 or 5
Heavy cutting, over 6 inches	5 or 6
Light gas welding, up to ½ inch	4 or 5
Medium gas welding, ⅛-½ inch	5 or 6
Heavy gas welding, over ½ inch	6 or 8
Shielded Metal-Arc Welding 1/16- to 5/32-inch electrodes	10
Inert-gas Metal-Arc Welding (Nonferrous) 1/16- to 5/32-inch electrodes	11
Inert-gas Metal-Arc Welding (Ferrous) 1/16- to 5/32-inch electrodes	12
Shielded Metal-Arc Welding:	
3/32 to ¼ inch electrodes	12
5/16 and 3/8 inch electrodes	14
Atomic Hydrogen Welding	10 to 14
Carbon Arc Welding	14

Subpart H—Tools and Related Equipment

§ 1503.71 General precautions.

(a) Hand lines, slings, or tackles of adequate strength shall be used to handle tools, materials and equipment so that employees can have their hands free when using ship's ladders and access ladders. The use of hose or power cables for this purpose shall be prohibited.

(b) When air tools of the reciprocating type are not in use, the dies and tools shall be removed.

(c) All portable, power-driven circular saws shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. When the tool is withdrawn from the work, the lower guard shall automatically and instantly return to the covering position.

(d) The moving parts of machinery on dry docks shall be adequately guarded.

(e) Before use, pneumatic tools shall be secured to the extension hose or whip by some positive means to prevent the tool from becoming accidentally disconnected from the whip.

§ 1503.72 Portable electric tools.

(a) The frames of portable electric tools and appliances shall be grounded either through a third wire in the cable containing the circuit conductors or through a separate wire which is grounded at the source of the current.

(b) Grounding circuits, other than by means of the structure of the vessel on which the tool is being used, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance which is low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.

(c) Portable electric tools which are held in the hand shall be equipped with switches of a type which must be manually held in the closed position.

(d) Worn or frayed electric cables shall not be used.

§ 1503.73 Hand tools.

(a) Employers shall not issue or permit the use of unsafe hand tools.

(b) Wrenches, including crescent, pipe, end and socket wrenches, shall not be used when jaws are sprung to the point that slippage occurs.

(c) Impact tools, such as drift pins, wedges, and chisels, shall be kept free of mushroomed heads.

(d) The wooden handles of tools shall be kept free of splinters or cracks and shall be kept tight in the tool.

§ 1503.74 Abrasive wheels.

(a) Floor stand and bench mounted abrasive wheels used for external grinding shall be provided with safety guards (protection hoods). The maximum angular exposure of the grinding wheel periphery and sides shall be not more than 90 degrees, except that when work

requires contact with the wheel below the horizontal plane of the spindle, the angular exposure shall not exceed 125 degrees. In either case the exposure shall begin not more than 65 degrees above the horizontal plane of the spindle. Safety guards shall be strong enough to withstand the effect of a bursting wheel.

(b) Floor and bench mounted grinders shall be provided with work rests which are rigidly supported and readily adjustable. Such work rests shall be kept a distance not to exceed ⅛ inch from the surface of the wheel.

(c) All portable abrasive wheels used for external grinding shall be provided with safety guards (protection hoods) meeting the requirements of paragraph (e) of this section, except as follows:

(1) When the work location makes it impossible, in which case a wheel equipped with safety flanges as described in paragraph (f) of this section shall be used.

(2) When wheels 2 inches or less in diameter which are securely mounted on the end of a steel mandrel are used.

(d) Portable abrasive wheels used for internal grinding shall be provided with safety flanges (protection flanges) meeting the requirements of paragraph (f) of this section, except as follows:

(1) When wheels 2 inches or less in diameter which are securely mounted on the end of a steel mandrel are used.

(2) If the wheel is entirely within the work being ground while in use.

(e) When safety guards are required, they shall be so mounted as to maintain proper alignment with the wheel, and the guard and its fastenings shall be of sufficient strength to retain fragments of the wheel in case of accidental breakage. The maximum angular exposure of the grinding wheel periphery and sides shall not exceed 180 degrees.

(f) When safety flanges are required they shall be used only with wheels designed to fit the flanges. Only safety flanges of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage shall be used.

(g) All abrasive wheels shall be closely inspected and ring tested before mounting to ensure that they are free from cracks or defects.

(h) Grinding wheels shall fit freely on the spindle and shall not be forced on. The spindle nut shall be tightened only enough to hold the wheel in place.

(i) The power supply shall be sufficient to maintain the rated spindle speed under all conditions of normal grinding. The rated maximum speed of the wheel shall not be exceeded.

(j) All employees using abrasive wheels shall be protected by eye protection equipment in accordance with the requirements of § 1503.81 (a) and (b), except when adequate eye protection is afforded by eye shields which are permanently attached to the bench or floor stand.

Subpart I—Personal Protective Equipment

§ 1503.81 Eye protection.

(a) *General precautions.* (1) All eye protection equipment required by the regulations in this part shall meet the specifications prescribed by the American Standard Safety Code for Head, Eye and Respiratory Protection, Z2.1.

(2) Eye protection equipment shall be maintained in good condition.

(3) Eye protection equipment which has previously been used shall be cleaned and disinfected before it is issued by the employer to another employee.

(4) Employees who wear corrective spectacles while engaged in eye hazardous work shall be protected by eye protection equipment of a type which can be worn over personal spectacles, except that glasses with prescription ground safety lenses may be worn in lieu of cover goggles when such glasses provide suitable protection against the hazard involved.

(b) *Protection against impact.* (1) In any operations such as chipping, caulking, drilling, riveting, grinding, and pouring babbitt metal, in which the eye hazard of flying particles, molten metal, or liquid chemical exists, employees shall be protected by suitable face shields or goggles meeting the requirements of paragraph (a) of this section.

(c) *Protection against radiant energy.* (1) In any operation in which the eye hazard of injurious light rays or other radiant energy exists, depending upon the intensity of the radiation to which employees are exposed, they shall be protected by spectacles, cup goggles, helmets or hand shields equipped with filter lenses in accordance with the requirements of paragraphs (a) and (c) (2) of this section.

(2) Filter lenses shall be of a shade number appropriate to the type of work to be performed as indicated in Table I–1 in § 1503.68, except that variations of one or two shade numbers are permissible to suit individual preferences.

(3) If filter lenses are used in the goggles worn under the helmet, the shade number of the lens in the helmet may be reduced so that the sum of the shade numbers of the two lenses will equal the value shown in Table I–1 in § 1503.68.

§ 1503.82 Respiratory protection.

(a) *General.* (1) All respiratory protective equipment required by these regulations shall carry the U.S. Bureau of Mines approval for the use for which it is intended. Respiratory protective equipment shall be used only for the purpose intended and no modifications of the equipment shall be made.

(2) Respiratory protective equipment shall be inspected regularly and maintained in good condition. Gas mask canisters and chemical cartridges shall be replaced as necessary so as to provide complete protection. Mechanical filters shall be cleaned or replaced as necessary so as to avoid undue resistance to breathing.

(3) Respiratory protective equipment which has been previously used shall be cleaned and disinfected before it is issued by the employer to another employee. Emergency rescue equipment shall be cleaned and disinfected immediately after each use.

(4) Employees required to use respiratory protective equipment approved for use in atmospheres immediately dangerous to life shall be thoroughly trained in its use. Employees required to use other types of respiratory protective equipment shall be instructed in the use and limitations of such equipment.

(5) When an air line respirator is used, the air line shall be fitted with a pressure regulating valve and a filter which will remove oil, water, and rust particles. The air intake shall be from a source which is free from all contaminants, such as the exhaust from internal combustion engines.

(6) In all cases, when an employee is stationed outside a compartment, tank or space as a tender or safety man for men working inside in an atmosphere immediately dangerous to life the tender shall have immediately available for emergency use respiratory protective equipment equivalent to that required for the men in the compartment. When a tender is stationed outside a compartment for men working inside in an atmosphere not immediately dangerous to life the tender shall wear respiratory protective equipment equivalent to that required for the men in the compartment if he is exposed for prolonged periods to the same concentration of atmospheric contaminants.

(b) *Protection in atmospheres immediately dangerous to life.* (1) Atmospheres immediately dangerous to life are those which contain less than 16.5 percent oxygen, or which by reason of the high toxicity of the contaminant, as in fumigation, or high concentration of the contaminant, as with carbon dioxide, would endanger the life of a person breathing them for even a short period of time.

(2) In atmospheres immediately dangerous to life the only approved types of respiratory protective equipment are the following:

(i) Self-contained breathing apparatus, in which the wearer carries with him a supply of oxygen, air, or an oxygen generating material.

(ii) Hose mask with blower, in which a hand or motor operated blower supplies air at high volume and low pressure through a large diameter hose through which the wearer can draw air in case the blower fails.

(iii) If there is known to be more than 16 percent oxygen and less than 2 percent gas by volume, a gas mask equipped with a canister approved for the particular type gas involved.

NOTE: A gas mask offers absolutely no protection in an atmosphere deficient in oxygen.

(3) Work in atmospheres immediately dangerous to life shall be performed only in an emergency, as when rescuing a man who has been overcome or when shutting off a source of contamination that cannot otherwise be controlled. When an employee enters such an atmosphere he shall be provided with and use an adequate, attended life line.

(4) In the vicinity of each vessel in which there is a danger of employees being exposed to an atmosphere immediately dangerous to life the employer shall have on hand and ready for use respira-

tory protective equipment approved for such use. When such equipment is required, one or more persons shall be thoroughly trained in the use of the equipment.

(c) *Protection against gaseous contaminants not immediately dangerous to life.* (1) Gaseous contaminants not immediately dangerous to life are gases present in concentrations that could be breathed for a short period without endangering the life of a person breathing them, but which might produce discomfort and possible injury after a prolonged single exposure or repeated short exposures.

(2) When employees are exposed to a gaseous contaminated atmosphere not immediately dangerous to life, they shall be protected by respiratory protective equipment approved for use in the type and concentration of the gaseous contaminant as follows:

(i) In high or unknown concentrations, a hose mask or an air line respirator. The use of either a hose mask or an air line respirator in lower concentrations is permissible.

(ii) In concentrations of ammonia of less than 3 percent or of other gases less than 2 percent, by volume, a canister type gas mask equipped with the proper type of canister. Different canisters are approved for specific use against the following cases or groups of gases: acid gases, hydrocyanic acid gas, chlorine gas, organic vapors, ammonia gas, carbon monoxide, or combination of the above.

(iii) In low concentrations (less than 0.1 percent by volume), a chemical cartridge respirator equipped with the type of cartridge approved for use against the particular gases or groups of gases listed in subdivision (ii) of this subparagraph.

(d) *Protection against particulate contaminants not immediately dangerous to life.* (1) When employees are exposed to unsafe concentrations of particulate contaminants, such as dusts and fumes, mists and fogs or combinations of solids and liquids, they shall be protected by either air line or filter respirators, except as otherwise provided in the regulations of this part.

(2) Filter respirators shall be equipped with the proper type of filter. Different filters are approved for specific protection against groups of contaminants, as follows:

(i) Pneumoconiosis-producing dust and nuisance dust filters which provide respiratory protection against pneumoconiosis-producing dusts, such as aluminum, cellulose, cement, charcoal, coal, coke, flour, gypsum, iron ore, limestone and wood.

(ii) Toxic dust filters which provide respiratory protection against toxic dusts that are not significantly more toxic than lead, such as arsenic, cadmium, chromium, lead, manganese, selenium, vanadium, and their compounds.

(iii) Mist filters which provide respiratory protection against pneumoconiosis-producing mists, chromic acid mists and nuisance mists.

(iv) Fume filters which provide respiratory protection against fumes (solid dispersoids or particulate matter formed by the condensation of vapors, such as those from heated metals and other substances.)

(v) Filters which provide respiratory protection against combinations of two or more of the contaminants described in subdivisions (i) through (iv) of this subparagraph.

(e) *Protection against combinations of gaseous and particulate contaminants not immediately dangerous to life.* (1) When employees are exposed to combinations of gaseous and particulate contaminants not immediately dangerous to life, they shall be protected by respiratory protective equipment approved for use in the type and concentrations of the contaminants, as follows:

(i) In high or unknown concentrations, a hose mask or an air line respirator. The use of either a hose mask or an air line respirator is permissible in lower concentrations.

(ii) In concentrations of gaseous contaminants of less than 2 percent by volume, a canister type gas mask with a combination canister approved for the particular type of gaseous contaminant as specified in paragraph (c)(2) of this section and a filter for the particular type of particulate contaminant as specified in paragraph (d)(1) of this section.

(iii) In low concentrations of gaseous contaminants (less than 0.1 percent by volume) a respirator equipped with the type of cartridge and filter as specified in subdivision (ii) of this subparagraph.

§ 1503.83 Head, foot and body protection.

(a) When employees are working in areas where there is danger of falling objects they shall be protected by protective hats.

(b) Protective hats shall meet the specifications contained in the American Standard Safety Code for Head, Eye and Respiratory Protection, Z–2.1. Hats without dielectric strength shall not be used where there is the possibility of contact with electric conductors.

(c) Protective hats which have been previously worn shall be cleaned and disinfected before they are issued by the employer to another employee.

(d) The employer shall arrange through means, such as vendors or local stores, or otherwise, to make safety shoes readily available to all employees, and shall encourage their use. Metal toe caps from which the covering has been worn shall be insulated when employees are working on exposed energized circuits of the vessel's electrical system.

(e) Employees shall not be permitted to wear excessively greasy clothing when performing hot work operations.

(f) Employees shall be protected by suitable gloves when engaged in operations hazardous to their hands.

§ 1503.84 Life saving equipment.

(a) *Buoyant working vests.* (1) When employees are working from small boats or floats, near the unguarded edges of decks, or over water on scaffolds without guard rails, they shall be protected by U.S. Coast Guard approved buoyant working vests.

(b) *Safety belts and life lines.* (1) When employees are working aloft, or over a solid surface on staging more than 5 feet high without guard rails, they shall be protected by safety belts equipped with life lines which are secured with a minimum amount of slack to a fixed structure.

(2) When employees are working in atmospheres immediately dangerous to life, they shall be protected by a safety belt and an adequate, attended life line.

(3) Prior to each use, belts and life lines shall be inspected for dry rot, chemical damage or other defects which may affect their strength. Defective belts and life lines shall not be used.

(4) When employees are working in any location requiring a safety belt and a life line, as required in subparagraph (1) or (2) of this paragraph, care shall be exercised to ensure that the life line is not cut, pinched or led over a sharp edge. In hot work operations or those involving the use of acids or caustics, the line shall be kept clear to avoid its being burned or weakened. In order to keep the life line continuously attached with a minimum of slack to a fixed structure, the attachment point of the life line shall be appropriately changed as the work progresses.

(c) *Life rings and ladders.* (1) At least three 30-inch Coast Guard approved life rings with lines attached shall be kept in easily visible and readily accessible places in the immediate vicinity of each vessel afloat on which work is being performed.

(2) At least one life ring with a line attached shall be located on each staging float alongside a vessel on which work is being performed.

(3) At least 90 feet of line shall be attached to each life ring. Life rings and lines shall be maintained in good condition.

(4) In the vicinity of each vessel on which employees are working over water or close to unguarded deck edges there shall be at least one portable or permanent ladder of sufficient length to assist employees to reach safety in the event that they fall into the water.

Appendix I

Threshold Limit Values for 1963

These values should be used as guides in the control of health hazards and should not be regarded as fine lines between safe and dangerous concentrations. They represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse effect. The values listed refer to time-weighted average concentrations for a normal workday. The amount by which these figures may be exceeded for short periods without injury to health depends upon a number of factors such as the nature of the contaminant, whether very high concentrations even for short periods produce acute poisoning, whether the effects are cumulative, the frequency with which high concentrations occur, and the duration of such periods. All must be taken into consideration in arriving at a decision as to whether a hazardous situation exists. Because it has been recognized that the threshold limits of certain acutely-acting substances may not provide a safety factor comparable to that of chronically-acting substances for which a time-weighted average applies, a "C" designation or "ceiling" has been affixed to such values indicat-

ing that the Threshold Limit Value should not be exceeded. The basis for the "C" listing is given in appendix C.

Special consideration should be given to the application of these values in assessing the health hazards which may be associated with exposure to mixtures of two or more substances. A brief discussion of basic considerations involved in developing threshold limit values for mixtures, and methods for their development, amplified by specific examples are given in appendix B.

Threshold limits are based on the best available information from industrial experience, from experimental studies, and, when possible, from a combination of the two. These values are based on various criteria of toxic effects or on marked discomfort; thus, they should not be used as a common denominator of toxicity, nor should they be considered as the sole criterion in proving or disproving diagnosis of suspected occupational disease.

These limits are intended for use in the field of industrial hygiene and should be interpreted and applied only by persons trained in this field. They are not intended for use, or for modification for use, (1) as a relative index of toxicity, by making a ratio of two limits, or (2) in the evaluation or control of community air pollution or air pollution nuisances, or (3) in estimating the toxic potential of continuous uninterrupted exposures.

RECOMMENDED VALUES (IN ALPHABETICAL ORDER)

Substance	ppm*	Mg/M³**
Acetaldehyde	200	360
Acetic acid	10	25
Acetic anhydride	5	20
Acetone	1,000	2,400
Acetonitrile	40	70
Acetylene tetrabromide	1	14
† Acrolein	0.1	0.25
Acrylonitrile—Skin	20	45
Aldrin (1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-dimethano-naphthalene)—Skin	—	0.25
† Allyl alcohol—Skin	2	5
Allyl chloride	1	3
C Allylglycidylether (AGE)	10	45
Allyl propyl disulfide	2	12
† Ammonia	50	35
Ammonium sulfamate (Ammate)	—	15
† Amyl acetate	100	525
Amyl alcohol (isoamyl alcohol)	100	360
Aniline—Skin	5	19
Antimony	—	0.5
ANTU (alpha naphthyl thiourea)	—	0.3
Arsenic	—	0.5
Arsine	0.05	0.2
Barium (soluble compounds)	—	0.5
C Benzene (benzol)—Skin	25	80
Benzidine	—	A¹
Benzyl chloride	1	5
Beryllium	—	0.002
Boron oxide	—	15
C Boron trifluoride	1	3
Bromine	0.1	0.7
Butadiene (1,3-butadiene)	1,000	2,200
2-Butanone (methyl ethyl ketone)	200	590
2-Butoxy ethanol (Butyl Cellosolve)	50	240
Butyl acetate (n-butyl acetate)	200	950
Butyl alcohol	100	300
tert. Butyl Alcohol	100	300
C Butylamine	5	15
n-Butylglycidylether (BGE)	50	270
Butyl mercaptan	10	35
p-tert. Butyltoluene	10	60
Cadmium oxide fume	—	0.1
Calcium arsenate	—	1
Carbon dioxide	5,000	9,000
Carbon disulfide—Skin	20	60
Carbon monoxide	100	110
Carbon tetrachloride—Skin	10	65
Chlordane (1,2,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene)	—	0.5
Chlorinated camphene, 60%-	—	0.5
Chlorinated diphenyl oxide	—	0.5
Chlorine	1	3
Chlorine dioxide	0.1	0.3

†1963 Revision.
*Parts of vapor or gas per million parts of air by volume at 25° C and 760 mm. Hg pressure.
**Approximate milligrams of particulate per cubic meter of air.
A Numbers, See Appendix A.

RECOMMENDED VALUES (IN ALPHABETICAL ORDER)—continued

Substance	ppm*	Mg/M³**
C Chlorine trifluoride	0.1	0.4
C Chloroacetaldehyde	1	3
Chlorobenzene (monochlorobenzene)	75	350
Chlorobromomethane	200	1,050
Chlorodiphenyl (42% Chlorine)—Skin	—	1
Chlorodiphenyl (54% Chlorine)—Skin	—	0.5
C Chloroform (trichloromethane)	50	240
1-Chloro-1-nitropropane	20	100
Chloropicrin	0.1	0.7
Chloroprene (2-chloro-1,3-butadiene)	25	90
Chromic acid and chromates (as CrO_3)	—	0.1
Cobalt	—	0.5
Crag (R) herbicide (sodium) 2-(2,4-dichlorophenoxyl ethanol hydrogen sulfate)	—	15
Cresol (all isomers)—Skin	5	22
Cyanide (as CN)—Skin	—	5
Cyclohexane	400	1,400
Cyclohexanol	50	200
Cyclohexanone	50	200
Cyclohexene	400	1,350
2,4-D (2,4-dichlorophenoxyacetic acid)	—	10
DDT (2,2-bis [p-chlorophenyll-1,1,1-trichloroethane)—Skin	—	1
Decaborane—Skin	0.05	0.3
Diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)	50	240
Diborane	0.1	0.1
1,2-Dibromoethane (Ethylene dibromide)	25	190
o-Dichlorobenzene	50	300
p-Dichlorobenzene	75	450
Dichlorodifluoromethane	1,000	4,950
1,1-Dichloroethane	100	400
1,2-Dichloroethane (ethylene dichloride)	50	200
1,2-Dichloroethylene	200	790
C Dichloroethyl ether	15	90
Dichloromonofluoromethane	1,000	4,200
C 1,1-Dichloro-1-nitroethane	10	60
Dichlorotetrafluoroethane	1,000	7,000
Dieldrin (1,2,3,4,10,10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4, 5,-8,-dimethanonaphthalene)—Skin	—	0.25
Diethylamine	25	75
Difluorodibromomethane	100	860
†C Diglycidyl ether (DGE)	0.5	2.8
Diisobutyl ketone	50	290
Dimethyl acetamide—Skin	10	35
Dimethylaniline (N-dimethylaniline)—Skin	5	25
Dimethylformamide	20	60
1,1-Dimethylhydrazine—Skin	0.5	1
Dimethylsulfate—Skin	1	5
Dinitrobenzene—Skin	—	1
Dinitrotoluene—Skin	—	1.5
Dinitro-o-cresol—Skin	—	0.2
Dioxane (diethylene dioxide)	100	360
Dipropylene glycol methyl ether	100	600
EPN (O-ethyl O-p-nitrophenyl thionobenzenephosphonate)—Skin	—	0.5
Ethyl acetate	400	1,400
Ethyl acrylate—Skin	25	100
Ethyl alcohol (ethanol)	1,000	1,900
Ethylamine	25	45
C Ethylbenzene	200	870
Ethyl bromide	200	890
Ethyl chloride	1,000	2,600
Ethyl ether	400	1,200
Ethyl formate	100	300
†C Ethyl mercaptan	20	52
Ethyl silicate	100	850
Ethylene chlorohydrin—Skin	5	16
Ethylenediamine	10	30
Ethylene glycol dinitrate (Combined EGDN+NG)—Skin	0.2	1.2
Ethylene imine—Skin	5	9
Ethylene oxide	50	90
2-Ethoxyethanol (Cellosolve)	200	740
2-Ethoxyethylacetate (Cellosolve Acetate)	100	540
Ferbam (ferric dimethyl dithiocarbamate)	—	15
Ferrovanadium dust	—	1
Fluoride (as F)	—	2.5
Fluorine	0.1	0.2
Fluorotrichloromethane	1,000	5,600
C Formaldehyde	5	6
Furfural	5	20
Furfuryl alcohol	50	200
Gasoline	500	2,000
Glycidol (2,3-Epoxy-1-propanol)	50	150
Heptane (n-heptane)	500	2,000
Hexane (n-hexane)	500	1,800
Hexanone (methyl butyl ketone)	100	410

RECOMMENDED VALUES (IN ALPHABETICAL ORDER)—continued

Substance	ppm*	Mg/M³**
† sec-Hexyl acetate	50	295
Hexone (methyl isobutyl ketone)	100	410
C Hydrazine—Skin	1	1.3
Hydrogen bromide	3	10
C Hydrogen chloride	5	7
Hydrogen cyanide—Skin	10	11
Hydrogen fluoride	3	2
Hydrogen peroxide, 90%	1	1.4
Hydrogen selenide	0.05	0.2
C Hydrogen sulfide	20	30
Hydroquinone	—	2
C Iodine	0.1	1
Iron oxide fume	—	15
Isophorone	25	140
Isopropylamine	5	12
Isopropylglycidylether (IGE)	50	240
Ketene	0.5	0.9
Lead	—	0.2
Lead arsenate	—	0.15
Lindane (hexachlorocyclohexane, gamma isomer)	—	0.5
Lithium hydride	—	0.025
Magnesium oxide fume	—	15
Malathion (o,o-dimethyl dithiophosphate of diethyl mercaptosuccinate)—Skin	—	15
C Manganese	—	5
Mercury—Skin	—	0.1
Mercury (organic compounds) —Skin	—	00.01
Mesityl oxide	25	100
Methoxychlor (2,2-di-p-methoxyphenyl-1, 1, 1-trichloroethane)	—	15
Methyl acetate	200	610
Methyl acetylene	1,000	1,650
Methyl acrylate—Skin	10	35
Methylal (dimethoxymethane)	1,000	3,100
Methyl alcohol (methanol)	200	260
C Methyl bromide—Skin	20	80
Methyl cellosolve (2-methoxyethanol)—Skin	25	80
Methyl cellosolve acetate (ethylene glycol monomethyl ether acetate)	25	120
C Methyl chloride	100	210
† Methyl chloroform (1,1,1-trichloroethane)	350	1,900
Methylcyclohexane	500	2,000
Methylcyclohexanol	100	470
Methylcyclohexanone	100	460
Methyl formate	100	250
Methyl isobutyl carbinol (methyl amyl alcohol)	25	100
†C Methyl mercaptan	20	40
α Methyl styrene	100	480
Methylene chloride (dichloromethane)	500	1,750
Monomethyl aniline—Skin	2	9
Molybdenum (soluble compounds)	—	5
(insoluble compounds)	—	15
Naphtha (coal tar)	200	800
Naphtha (petroleum)	500	2,000
β-Naphthylamine	—	A¹
Nickel carbonyl	0.001	0.007
Nicotine—Skin	—	0.5
Nitric acid	10	25
p-Nitroaniline—Skin	1	6
Nitrobenzene—Skin	1	5
Nitroethane	100	310
C Nitrogen dioxide	5	9
C Nitroglycerin (combined EGDN+NG)—Skin	0.2	2
Nitromethane	100	250
1-Nitropropane	25	90
2-Nitropropane	25	90
N-Nitrosodimethylamine (Dimethylnitrosamine)—Skin	A¹	—
Nitrotoluene—Skin	5	30
Octane	500	2,350
Osmium tetroxide	—	0.002
Ozone	0.1	0.2
Parathion (O, O, diethyl-O-p-nitrophenyl thiophosphate) —Skin	—	0.1
Pentaborane	0.005	0.01
Pentachloronaphthalene—Skin	—	0.5
Pentachlorophenol—Skin	—	0.5
Pentanone (methyl propyl ketone)	200	700
Pentane	1,000	2,950
Perchloroethylene (tetrachloroethylene)	100	670
Perchloromethyl mercaptan	0.1	0.8
Perchloryl fluoride	3	13.5
Phenol—Skin	5	19
Phenylglycidylether (PGE)	50	310
Phenylhydrazine—Skin	5	22
Phosdrin (2-carbomethoxy-1-methyl vinyl dimethyl phosphate)	—	0.1
Phosgene (carbonyl chloride)	1	4
† Phosphine	0.3	0.4
Phosphoric acid	—	1
Phosphorus (yellow)	—	0.1
Phosphorus pentachloride	—	1
Phosphorus pentasulfide	—	1

RECOMMENDED VALUES (IN ALPHABETICAL ORDER)—continued

Substance	ppm*	Mg/M³**
Phosphorus trichloride	0.5	3
Picric acid—Skin	—	0.1
Platinum (soluble salts)	—	0.002
Propyl acetate	200	840
Propyl alcohol (isopropyl alcohol)	400	980
Propyl ether (isopropyl ether)	500	2,100
n-Propyl nitrate	25	110
Propylene dichloride (1,2-dichloropropane)	75	350
Propylene imine—Skin	25	60
Propylene oxide	100	240
Pyrethrum	—	5
Pyridine	5	15
Quinone	0.1	0.4
Rotenone (commercial)	—	5
Selenium compounds (as Se)	—	0.1
Sodium fluoroacetate (1080)—Skin	—	0.05
Sodium hydroxide	—	2
Stibine	0.1	0.5
Stoddard solvent	500	2,900
Strychnine	—	0.15
Styrene monomer (phenylethylene)	100	420
Sulfur dioxide	5	13
Sulfur hexafluoride	1,000	6,000
Sulfuric acid	—	1
C Sulfur monochloride	1	6
Sulfur pentafluoride	0.025	0.25
Sulfuryl fluoride	5	20
2,4,5T (2,4,5-Trichlorophenoxyacetic acid)	—	10
TEDP (tetraethyl dithionopyrophosphate)—Skin	—	0.2
Teflon (R) decomposition products	—	A⁴
TEPP (tetraethyl pyrophosphate)—Skin	—	0.05
Tellurium	—	0.1
1,2,2,2 - Tetrachloroethane—Skin	5	35
Tetrahydrofuran	200	590
Tetranitromethane	1	8
Tetryl (2,4,6-trinitrophenylmethylnitramine)—Skin	—	1.5
Thallium (soluble compounds)—Skin	—	0.1
Thiram (tetramethyl thiuram disulfide)	—	5
Titanium dioxide	—	15
C Toluene (toluol)	200	750
o-Toluidine—Skin	5	22
C Tolyene-2,4-diisocyanate	0.02	0.14
Trichloroethylene	100	520
Trichloronaphthalene—Skin	—	5
1,2,3-Trichloropropane	50	300
1,1,2-Trichloro 1,2,2-trifluoroethane	1,000	7,600
Triethylamine	25	100
Trifluoromonobromomethane	1,000	6,100
Trinitrotoluene—Skin	—	1.5
Triorthocresyl phosphate	—	0.1
Triphenyl phosphate	—	3
Turpentine	100	560
Uranium (soluble compounds)	—	0.05
(insoluble compounds)	—	0.25
Vanadium C (V_2O_5 dust)	—	0.5
(V_2O_5 fume)	—	0.1
C Vinyl chloride (chloroethylene)	500	1,300
Vinyl toulene	100	480
Warfarin (3[α acetonylbenzyl]-4-hydroxycoumarin)	—	0.1
Yttrium	—	5
C Xylene (xylol)	200	870
Xylidene—Skin	5	25
Zinc oxide fume	—	5
Zirconium compounds (as Zr)	—	5

NOTE: The word "Skin" following a substance indicates that the substance can penetrate the skin to contribute to the exposure and threshold limit value should be reduced accordingly.

†1963 Revision.
*Parts of vapor or gas per million parts of air by volume at 25° C and 760 mm. Hg pressure.
**Approximate milligrams of particulate per cubic meter of air.
A Numbers, See Appendix A.

Radioactivity: For permissible concentrations of radio-isotopes in air, see U.S. Department of Commerce, National Bureau of Standards, Handbook 69, "Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure," June 5, 1959. Also, see U.S. Department of Commerce, National Bureau of Standards, Handbook 59, "Permissible Dose from External Sources of Ionizing Radiation," September 24, 1954, and addendum of April 15, 1958.

MINERAL DUSTS

Substance	m.p.p.c.f.‡
SILICA	
Crystalline	
Quartz, Threshold Limit calculated from the formula	250 / %SiO₂†+5
Cristobalite, Threshold Limit calculated from the formula	
Amorphous, including natural diatomaceous earth	20
SILICATES (less than 1% crystalline silica)	
Asbestos	5
Mica	20
Soapstone	20
Talc	20
Portland Cement	50
Miscellaneous (less than 1% crystalline silica)	50

Conversion factors
mppcf x 35.3=million particles per cubic meter
=particles per c.c.

‡Millions of particles per cubic foot of air, based on impinger samples counted by light-field technics.
†The percentage of crystalline silica in the formula is the amount determined from air-borne samples, except in those instances in which other methods have been shown to be applicable.

TENTATIVE VALUES

Substance	ppm*	Mg/M³**
C tert. Butyl chromate (as CrO_3)—Skin	—	0.1
† Calcium oxide	—	5
Camphor	—	2
† Copper Fume	—	0.1
Dusts & Mists	—	1.0
DDVP (O, O-Dimethyl-2,2 - dichlorovinyl phosphate)	—	1
† Demeton (R) (Systox)	—	0.1
Endrin (1,2,3,4,10,10,-hexachloro-6, 7-epoxy-1,4,4a, 5,6,7,8,8a-octa hydro 1,4-endo - 5,8 - dimethanonaphthalene)—Skin	—	0.1
Epichlorhydrin	5	19
Ethanolamine	3	6
† Graphite	—	15 mppcf
† Hafnium	—	0.5
Heptachlor (1,4,5,6,7,8,8a-heptachloro-3a,4,7,7a-tetrahydro - 4,7 - methanoindene)	—	0.5
† Methylamine	25	31
† Methyl Methacrylate	100	410
†C Methylene bis phenylisocyanate	0.02	0.2
† Mineral Wool (Fiberglas)	—	2
† Naphthalene	10	50
Oil (mineral)	—	5
† β-Propiolactone	—	A⁵
† Silver	—	0.05
† Tantalum	—	5
† 1,1,1,2, - Tetrachloro - 2,2, - difluoroethane	1,000	8,340
† 1,1,2,2 - Tetrachloro - 1,2 - difluoroethane	500	4,170
† Tetraethyl lead	—	0.075
† Tin (inorganic compounds)	—	2
(organic compounds as Sn)—Skin	—	0.1

†1962 Additions.
*Parts of vapor or gas per million parts of air by volume at 25° C and 760 mm. Hg pressure.
**Approximate milligrams of particulate per cubic meter of air.
A numbers, See Appendix A.

APPENDIX A

A¹ Benzidine. Because of high incidence of bladder tumors in man, any exposure, including skin, is extremely hazardous.

A² β-Naphthylamine. Because of the extremely high incidence of bladder tumors in workers handling this compound, and the inability to control exposures, β-naphthylamine has been prohibited from manufacture, use and other activities that involve human contact by the State of Pennsylvania.

A³ N-Nitrosodimethylamine. Because of extremely high toxicity and presumed carcinogenic potential of this compound, contact by any route should not be permitted.

A⁴ Teflon ® decomposition products. At least one identified component of Teflon decomposition products is extremely toxic, but in the absence of more complete toxicity information and suitable analytic methods, a definite threshold limit value is not recommended at this time; but air concentrations should be minimal.

A⁵ β-Propiolactone. Because of high acute toxicity and demonstrated skin tumor production in animals, contact by any route should be avoided.

APPENDIX B

THRESHOLD LIMIT VALUES FOR MIXTURES

When two or more hazardous substances are present, their combined effect, rather than that of either individually, should be given primary consideration. In the absence of information to the contrary, the effects of the different hazards should be considered as additive. That is, if the sum of the following fractions,

$$\frac{C_1}{T_1}+\frac{C_2}{T_2}+\cdots\frac{Cn}{Tn}$$

exceeds unity, then the threshold limit of the mixture should be considered as being exceeded. C indicates the observed atmospheric concentration, and T_1 the corresponding threshold limit. (See example 1A.a.)

Exceptions to the above rule may be made when there is good reason to believe that the chief effects of the different harmful substances are not in fact additive, but independent as when purely local effects on different organs of the body are produced by the various components of the mixture. In such cases the threshold limit ordinarily is exceeded only when at least one member of the series

$$\left(\frac{C_1}{T_1}\text{ or }\frac{C_2}{T_2}\text{ etc.}\right)$$

itself has a value exceeding unity. (See Example 1A.b.)

Antagonistic action or potentiation may occur with some combinations of atmospheric contaminants. Such cases at present must be determined individually. Potentiating or antagonistic agents are not necessarily harmful by themselves. Potentiating effects of exposure to such agents by routes other than that of inhalation is also possible, e.g., imbibed alcohol and inhaled narcotic (trichlorethylene). Potentiation is characteristically exhibited at high concentrations, less probably at low.

When a given operation or process characteristically emits a number of harmful dusts, fumes, vapors or gases, it will frequently be only feasible to attempt to evaluate the hazard by measurement of a single substance. In such cases, the threshold limit used for this substance should be reduced by a suitable factor, the magnitude of which will depend on the number, toxicity and relative quantity of the other contaminants ordinarily present.

Examples of processes which are typically associated with two or more harmful atmospheric contaminants are welding, automobile repair, blasting, painting, lacquering, certain foundry operations, diesel exhausts, etc. (Example 2.)

THRESHOLD LIMIT VALUES FOR MIXTURES

EXAMPLES

1A. General case, where air is analyzed for each component.

a. ADDITIVE EFFECTS

$$\frac{C_1}{T_1} + \frac{C_2}{T_2} + \frac{C_3}{T_3} + \ldots \frac{C_n}{T_n} = 1$$

Air contains 5 ppm of carbon tetrachloride (TLV, 10), 20 ppm of ethylene dichloride (TLV,50) and 10 ppm of ethylene dibromide, (TLV, 25).

$$\frac{5}{10} + \frac{20}{50} + \frac{10}{25} = \frac{65}{50} = 1.3$$

Threshold limit is exceeded.

b. INDEPENDENT EFFECTS

Air contains 0.15 mg/m³ of lead (TLV, 0.2) and 0.7 mg/m³ of sulfuric acid (TLV, 1).

$$\frac{0.15}{0.20} = 0.75; \frac{0.7}{1} = 0.7$$

Threshold limit is not exceeded.

1B. Special case when source of contaminant is a mixture and atmospheric composition is assumed similar to that of original material, i.e. vapor pressure of each component is the same at the observed temperature.

a. ADDITIVE EFFECTS, approximate solution.

1. A mixture of equal parts (1) trichloroethylene (TLV, 100), and (2) methyl chloroform (TLV, 350).

$$\frac{C_1}{100} + \frac{C_2}{350} = \frac{C_m}{T_m}$$

Solution applicable to "spot" solvent mixture usage, where all or nearly all, solvent evaporates.

$$C_1 = C_2 = \frac{1}{2} C_m$$

$$\frac{C_1}{100} + \frac{C_1}{350} = \frac{2C_1}{T_m}$$

$$\frac{7C_1}{700} + \frac{2C_1}{700} = \frac{2C_1}{T_m}$$

$$T_m = 700 \times \frac{2}{9} = 155 \text{ ppm}$$

1B.b. General Exact Solution for Mixtures of N Components With Additive Effects and Different Vapor Pressures.

(1) $\frac{C_1}{T_1} + \frac{C_2}{T_2} + \ldots + \frac{C_n}{T_n} = 1;$

(2) $C_1 + C_2 + \ldots + C_n = T;$

(2.1) $\frac{C_1}{T} + \frac{C_2}{T} + \ldots + \frac{C_n}{T} = 1.$

By the Law of Partial Pressures,

(3) $C_i = ap_i$.

And by Raoult's Law,

(4) $p_i = F_i p_i°$.

Combine (3) and (4) to obtain

(5) $C_i = aF_i p_i°$.

Combining (1), (2.1), and (5), we obtain

(6) $\frac{F_1 p_1°}{T} + \frac{F_2 p_2°}{T} + \ldots + \frac{F_n p_n°}{T} = \frac{F_1 p_1°}{T_1} + \frac{F_2 p_2°}{T_2} + \ldots + \frac{F_n p_n°}{T_n}$, and solving for T,

(6.1) $$T = \frac{F_1 p_1° + F_2 p_2° + \ldots + F_n p_n°}{\frac{F_1 p_1°}{T_1} + \frac{F_2 p_2°}{T_2} + \ldots + \frac{F_n p_n°}{T_n}}$$

or

(6.2) $$T = \frac{\sum_{i=1}^{i=n} F_i p_i°}{\sum_{i=1}^{i=n} \frac{F_i p_i°}{T_i}}$$

T = Threshold limit value in ppm.
C = Vapor concentration in ppm.
p = Vapor pressure of component in solution.
p° = Vapor pressure of pure component.
F = Mol fraction of component in solution.
a = A constant of proportionality.
Subscripts 1,2, ... n relate the above quantities to components 1,2, ... n, respectively.
Subscript i refers to an arbitrary component from 1 to n.
Absence of subscript relates the quantity to the mixture.

Solution to be applied when there is a reservoir of the solvent mixture whose composition does not change appreciably by evaporation.

Exact Arithmetic Solution of Specific Mixture

	Mol. wt.	Density	T	p° at 25°C	Mol fraction in half-and half solution by volume
Trichloroethylene (1)	131.4	1.46 g/ml	100	73mm Hg	0.527
Methylchloroform (2)	133.42	1.33 g/ml	350	125mm Hg	0.473

$$F_1 p_1° = (0.527)(73) = 38.2$$
$$F_2 p_2° = (0.473)(125) = 59.2$$

$$T = \frac{38.2 + 59.2}{\frac{38.2}{100} + \frac{59.2}{350}} = \frac{(97.4)\ (350)}{133.8 + 59.2} = \frac{(97.4)\ (350)}{193.0} = 177$$

T = 177 ppm (Note difference in T.L.V. when account is taken of vapor pressure and mol fraction in comparison with above example where such account is not taken).

2. A mixture of one part of (1) parathion (TLV, 0.1) and two parts of (2) EPN (TLV, 0.5).

$$\frac{C_1}{0.1} + \frac{C_2}{0.5} = \frac{C_{m1}}{T_m}\ C_2 = 2C_1$$

$$C_m = 3C_1$$

$$\frac{C_1}{0.1} + \frac{2C_1}{0.5} = \frac{3C_1}{T_m}$$

$$\frac{7C_1}{0.5} = \frac{3C_1}{T_m}$$

$$T_m = \frac{1.5}{7} = 0.21 \text{ mg/m}^3$$

1C. INDEPENDENT EFFECTS

1. From naphtha (TLV, 500) containing 10 mole per cent benzene (TLV, 25) the narcotic effects can considered as approximately the same as that of benzene-free naphtha.

The blood effects can be considered as due to the benzene alone.

For intermittent exposure, a TLV of 500 ppm may be used as long as the average concentration does not exceed $25 \times \frac{100}{10} = 250$ ppm, the TLV based on the benzene content.

2. Diesel engine exhaust contains several irritants, one of which is nitrogen dioxide. A limit of 2 ppm NO_2 has been found to correlate fairly well with the beginning of subjective (irritation) effects from such gases, although no subjective effects are experienced from NO_2 alone at 5 ppm.

Appendix C

BASES FOR ASSIGNING LIMITING "C" VALUES*

T.L.V. RANGE ppm° or mg/m³	Permitted Fluctuation Factor of T.L.V. for 5, 10 or 30 min.	Examples
0 to 1	3	Boron trifluoride (1 ppm) at 3 ppm if repeatedly encountered for periods of 5, 10, or 30 minutes, may lead to pneumonitis; a "C" listing recommended.
1+ to 10	2	
10+ to 100	1.5	Ethyl benzene (200 ppm) at 250 ppm if repeatedly encountered for periods of 5 or 10 minutes may prove intolerably irritating to the eyes; a "C" listing recommended.
100+ to 1000	1.25	

* According to this limitation, the presently listed TLVs will or will not be candidates for a "C" (ceiling) listing. 1963 TLVs not coming within this limitation will bear a "C" before the substance name. Judgment is based on whether the excursions in concentration under the time limits stated may result in a) intolerable irritation, b) chronic or irreversible tissue change, or c) narcosis of sufficient degree to increase accident proneness or materially reduce work efficiency.

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